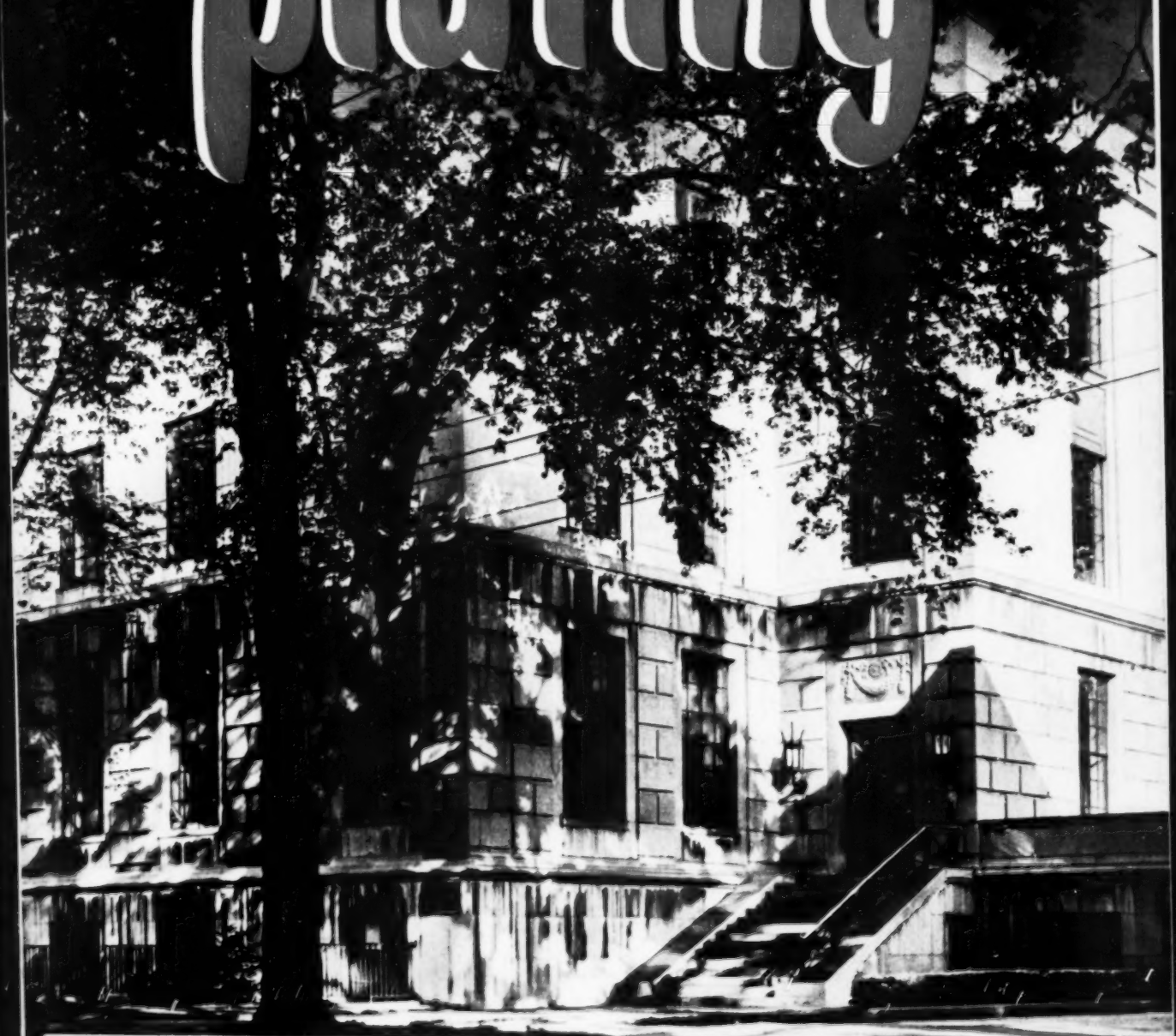
VOLUME 41
NUMBER 3

MARCH, 1954

plating



POSTMASTER: IF UNDELIVERABLE RETURN TO
5800 N. MARVINE ST., PHILADELPHIA 41, PA.
RETURN POSTAGE GUARANTEED

University Microfilms
313 N. First St.
Ann Arbor, Michigan

NICKEL SOLUTION ANALYSIS

See Contents Page 259

for all
Barrel Tumbling Problems
Consult Clepo...

Burr-eens FOR FASTER CUTTING

SPEE-D-BURR FOR FINE FINISHING OF STEEL

CUTTING COMPOUNDS

POLISHING COMPOUNDS

BURNISHING COMPOUNDS

BARRELS ALL TYPES

SEPARATORS DRYERS

RUST PREVENTATIVE

Pioneer in barrel finishing technique materials, etc. for over 20 years.

Our experienced servicemen and well equipped tumbling laboratory are available to you without cost.

FREDERICK GUMM Chemical Company, Inc.

538 FOREST ST., KEARNY, N.J.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 300.

The Newest Products of Research go into ENTHONE *Metal Cleaners*

Enthone's extensive research in surface chemistry insures the use of the most modern products for metal cleaning.

KEEP UP TO DATE
. . . get this FREE literature on the newest metal cleaning processes . . .

Powerful new synthetic surface-active materials assure

HIGH DETERGENCY

FAST ACTION

FREE RINSING

Just fill out and mail

☐ CLEANER 160 — An all purpose cleaner for soak or electrolytic cleaning of copper, brass, nickel-silver, zinc and steel.

☐ CLEANER 69S — Powerful cleaner for soak or electrolytic cleaning of steel.

☐ ETCHALUME — Non-scaling, fast acting, etch cleaner for aluminum.

☐ ALUMINUM CLEANER "NE" — A non-etching cleaner for aluminum.

☐ EMULSION CLEANER 75 — An emulsifiable solvent cleaner for rapid removal of solid dirt and oils from all metals.

COMPANY NAME_____

MY NAME_____

ADDRESS_____

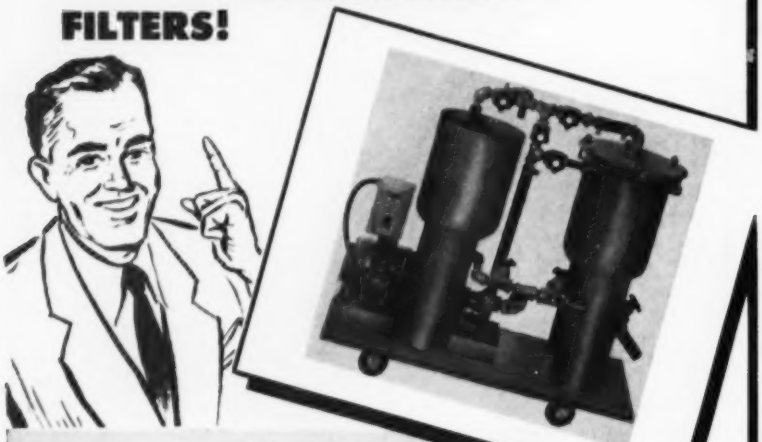
CITY_____

STATE_____

ENTHONE
INCORPORATED
442 ELM STREET
NEW HAVEN, CONNECTICUT

METAL FINISHING PROCESSES ELECTR[illegible]CHEMICALS

ELIMINATE COSTLY MAINTENANCE WITH *NEW* PERMANENT FILTERS!



NO BAGS, NO SHEETS, NO PADS

You can eliminate the nuisance of replacing filters with the new SICO tubular method of filteration. The "lift-out" feature allows you to remove the filter elements as one unit. In one simple operation the elements can be hosed off outside of the filter without the usual practice of handling many parts. Also, a periodic schedule of back washing the filters can be accomplished by merely operating 3 valves. Unnecessary down-time is eliminated which saves you money.

LARGE VOLUME FILTERING IN COMPACT UNIT

SICO units are available for all volume requirements. Permanent filter screens will not tend to clog by swelling or changes in shape. This assures maximum volume at all times. Since stainless steel filter elements do not absorb, filters used on acid solutions can be used on alkaline solutions without fear of contamination.

TROUBLE FREE OPERATION

Fine qualities of workmanship and materials assure you of reliability in a SICO unit. Mechanical seals reduce pump packing leaks to a minimum. Customers report over a year of daily use without maintenance.

STEADFAST INDUSTRIES, INC.
4731 WEST MADISON STREET · CHICAGO 44, ILLINOIS

CLIP and MAIL TODAY

Send me more information on permanent filters.

Name_____

Company_____

Address_____

In This Issue

The Polarographic Analysis of Nickel Plating Solutions by J. V. Petrocelli and G. Tatoian is a paper in which the authors present data on the application of the method in the determination of nickel sulfate, nickel chloride and boric acid. General principles and techniques are outlined and a new manual polarograph is described which has been specifically designed and developed for use in plating solution analyses. The effect of *p*H and brighteners is noted. Nine figures, two tables complete the presentation.

The Use of Unplasticized Polyvinyl Chloride in Electroplating Plants by L. N. Thomas. The author reviews the development of unplasticized PVC in Germany and lists several typical installations of the material along with serviceability results in those installations. Several suggested applications with a general discussion to indicate possible uses in plating rooms are given. Four figures and two tables complete the article.

Industrial Waste Control by D. Gardner Foulke is a review of the latest information on the problem of stream pollution. The recent meeting of the National Technical Task Committee on Industrial Wastes is reported on and the functions of the committee are listed. Trends in waste disposal control, the work of ORSANCO, and recent state and federal legislation on the subject are discussed.

Cleaning and Preparation of Metals for Electroplating. VIII. Effect of Oxide Films—A Survey of the Literature by Henry B. Linford and David O. Feder. The paper is the first report on the second phase of work being conducted by AES Research Project No. 12. Discussed are: (1) a working definition of surface cleanliness; (2) the methods by which oxide films are formed and some of their pertinent characteristics; (3) the mechanism of metal deposition, crystal formation and adhesion; (4) the interfacial phenomena occurring during the plating process on to oxide-soiled metal surfaces and (5) the effects of these processes and of the films on the electroplate.

For page numbers, see Table of Contents, page 259

Published monthly at 5800 N. Marvine St., Philadelphia 41, Pa. Entered as second class matter July 1, 1946, at the Post Office at Philadelphia, Pa., under Act of August 24, 1916. Subscriptions: Domestic and Canada, $4.00 for 1 year, $7.00 for 2 years 50c per copy; Foreign, $8.00 per year, $1.00 per copy.

NOW AVAILABLE!

ROHCO TEST EQUIPMENT gives the answers to plating bath control—quickly and simply—in thousands of modern plants.

HERE is the latest, complete brochure describing **ROHCO** specialized units so that the laboratory technician or production supervisor may select the proper Hull Cells, Rectifiers, and other accessories for his requirements.

ROHCO Plating Test Methods provide you with the best assurance for maintaining maximum production efficiency and quality.

Send Coupon For Your Copy . . . TODAY!

R. O. HULL & COMPANY, INC.

1302 Parsons Court • Rocky River, 16, Ohio

Canada: Armalite Company, Ltd., Toronto 6, Canada

OTHER ROHCO PRODUCTS: NO-CRO-MIST® • ROHCO 303 STILL ZINC BRIGHTENER • ZINC PURIFIER • RINS-AID • ROHCO 100 BARREL ZINC BRIGHTENER • ROHCO® 20XL CADMIUM BRIGHTENER • AIRCRAFT BLACK CADMIUM DIP®

ROHCO

JUST PIN THIS COUPON TO YOUR LETTERHEAD!

R. O. HULL & COMPANY, INC.
1302 Parsons Court
Rocky River 16, Ohio

Please send FREE brochure "ROHCO" Test Equipment.

Name..... Title.....
Company.....
Street Address.....
City..... Zone..... State.....

Industry News

H-VW-M Expands West Coast Facilities. In a move to expand its West Coast activities, H-VW-M Co., Matawan, N. J., has acquired the assets, customer lists, good will, personnel and existing business of the electroplating equipment and supply division of the A. J. Lynch Co. in California.

H-VW-M will maintain offices in the Lynch buildings at Los Angeles and San Francisco.

Harold R. Smallman, assistant vice-president of H-VW-M, will continue supervision of the company's activities on the West Coast. Three Lynch salesmen join H-VW-M. They are William A. Nairne, G. Stuart Krentel who will cover the Los Angeles territory, and A. H. Nicholson who will continue serving the San Francisco area.

Oakite Annual Technical Sales Conference

Field service representatives of Oakite Products, Inc., are shown as they gathered for the third of a series of regional technical-sales conferences at the Hotel Roosevelt, New York City. The men, from the company's Cleveland, Southern, New England, Philadelphia, and New York and Metropolitan divisions, discussed new materials and methods to help industry keep costs down while solving ever more complicated production and maintenance cleaning problems. Similar meetings were held in San Francisco and Chicago for other divisions of the company's technical field service organization

Distribution for H-VW-M in Seattle will still be handled by the Carl F. Miller Co., and in Portland by the Zehrung Chemical Co.

The A. J. Lynch Company will devote their entire efforts towards their original and basic business of warehousing and distributing bulk chemicals for industry.

New Representative for Rapid Electric. The Rapid Electric Co., 2881 Middletown Rd., Bronx, N. Y., takes pleasure in announcing that Ardco Incorporated of 5000 W. 73rd St., Chicago, Ill., has been appointed as their exclusive direct factory representatives in the metropolitan Chicago area. Ardco Inc. will supervise all aspects of the distribution of the Rapid Electric precision engineered se-

More Sustaining Memberships

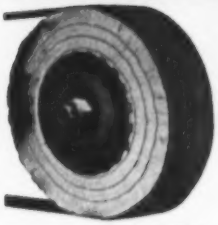
The Detroit and New York Branches continue their recent fast pace in the reporting to Headquarters of new sustaining members in support of the AES Research Program. At the same time the Allentown-Reading Branch contributed still another addition to the growing list. The newest organizations covered by these reports are:

L. F. Grammes & Sons, Inc.
Allentown, Pa.

Lea-Ronal, Inc.
Long Island City 1, N. Y.

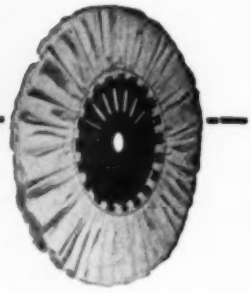
Solventol Chemical Products, Inc.
Detroit 3, Mich.

A FEW OF THE MANY
FORMAX
PRODUCTS



STYLE C-20
CONTACT WHEELS
and F-26 Belt Lubricant

A C-20 flexible Contact Wheel will form itself to the shape of the work and permit the abrasive felt to polish contoured surfaces and F-26 Abrasive Belt Lubricant will increase belt life by preventing loading and glazing. Produces finer, smoother and brighter surfaces through lubrication.



ZIPPO BUFFS

These famous long-wearing buffs run cool under all buffing conditions. Constructed of high count bias-cut cloth or sisal mounted on safe steel centers. Available in a wide range of densities and center diameters.

A complete line of buffing compounds in bar form as well as in liquid form for brush or spray application. Also Flex-A-Glu polishing wheel cements.

Our Laboratory and Sales Engineering staff would welcome the opportunity to be of help in solving your finishing problems.

Send for descriptive literature

FORMAX MFG. CORP.
DETROIT 7, MICHIGAN
"THE FOUR McALEERS"

MANUFACTURED IN CANADA BY JOHN GALLOWAY LTD., KITCHENER, ONT.

CHEMICALS ACP PROCESSES

PHOSPHATE COATINGS TO MAKE YOUR PRODUCT DURABLE*

PIONEERING RESEARCH AND DEVELOPMENT SINCE 1914

For more than a third of a century, ACP research chemists and ACP technical representatives in the field have pioneered in the science of metal preservation. They have developed surface treating chemicals which either protect metals directly, or create a superior bond for decorative and protective paint finishes, and now, ACP chemicals and processes are being used the world around to reduce costs, speed production and add to the life-span of countless products.

ACP metal protective chemicals include: protective coating chemicals for steel, zinc and aluminum; metal cleaners and rust removers; final rinse controls; pickling acid inhibitors; copper coating chemicals; soldering fluxes; alkali cleaners and addition agents; copper stripping and brightening solutions.

PAINT BONDING

"GRANODINE"® zinc phosphate coatings improve paint adhesion on automobiles, refrigerators, projectiles, rockets, and many other steel and iron fabricated units or components.

"LITHOFORM"® zinc phosphate coatings, make paint stick to galvanized iron and other zinc and cadmium surfaces.

"ALODINE"® protective coatings provide improved paint adhesion and high corrosion-resistance for aircraft and aircraft parts, awnings, wall tile, signs, bazookas, and many other products made of aluminum.

RUST PROOFING

"PERMADINE"® zinc phosphate coatings provide rust and corrosion proofing for nuts, bolts, screws, hardware, tools, guns, cartridge clips, and many other industrial and ordnance items.

PROTECTION FOR FRICTION SURFACES

"THERMOIL GRANODINE"® manganese-iron phosphate coatings provide both rust proofing and wear resistance — anti-galling, safe break-in, friction on rubbing parts.

IMPROVED DRAWING AND COLD FORMING

"GRANODRAW"® zinc phosphate coatings make possible improved drawing, cold forming and extrusion on such steel products as sheets for stamping, bumpers, parts to be formed, prior to plating or painting, cartridge cases, etc.

*Made, Sold, and Serviced By A Pioneer In Protective Coatings For Metals . . .

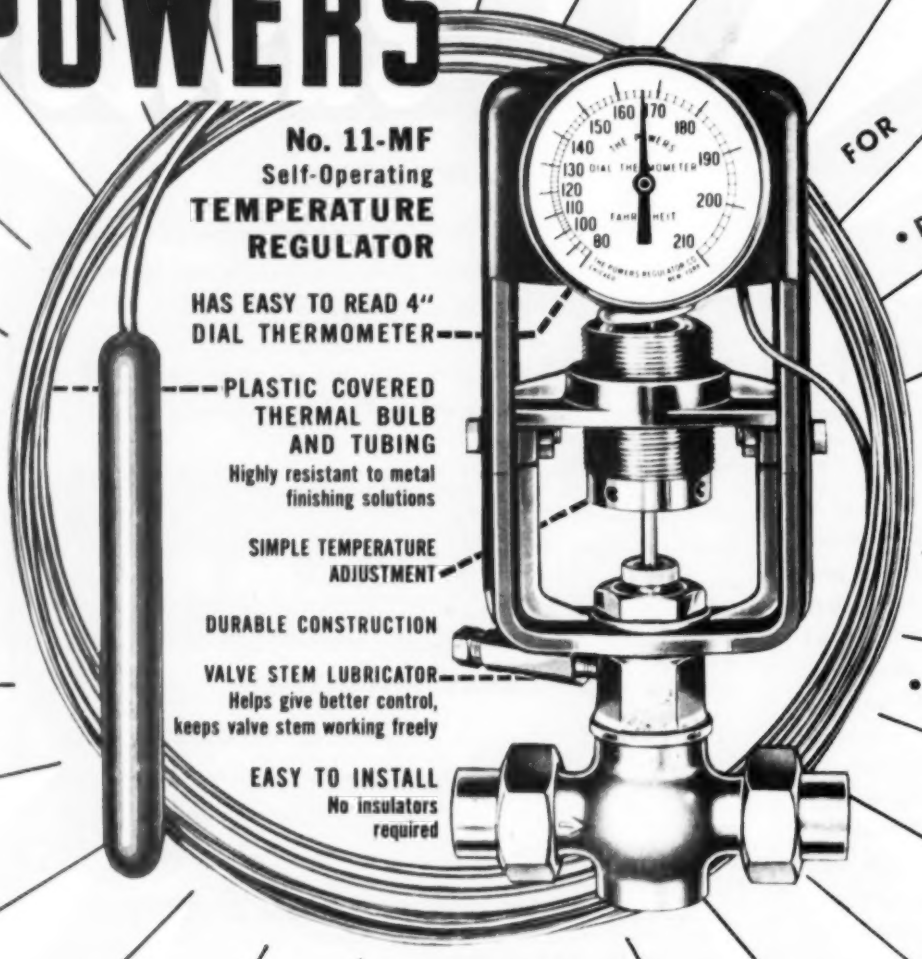
AMERICAN CHEMICAL PAINT COMPANY

General Offices: Ambler, Penna.

Detroit, Michigan *Niles, California* *Windsor, Ontario*

POWERS

No. 11-MF
Self-Operating
TEMPERATURE REGULATOR



HAS EASY TO READ 4" DIAL THERMOMETER

PLASTIC COVERED THERMAL BULB AND TUBING
Highly resistant to metal finishing solutions

SIMPLE TEMPERATURE ADJUSTMENT

DURABLE CONSTRUCTION

VALVE STEM LUBRICATOR
Helps give better control, keeps valve stem working freely

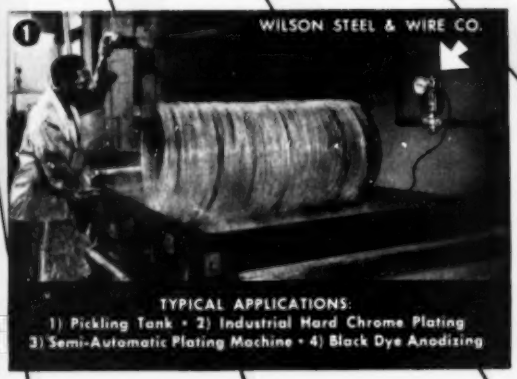
EASY TO INSTALL
No insulators required

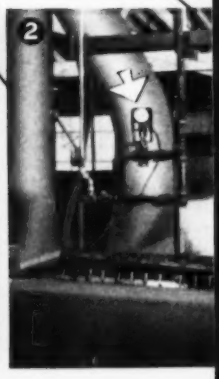
FOR
- PLATING
- ANODIZING
- BONDERIZING
- CLEANING
- PICKLING
- RINSE TANKS

NEW! Improved!

Temperature Control
FOR METAL FINISHING PROCESSES

Helps Workers Produce a Better Product
Prevents OVER-heating • Saves Steam





TYPICAL APPLICATIONS:
1) Pickling Tank • 2) Industrial Hard Chrome Plating
3) Semi-Automatic Plating Machine • 4) Black Dye Anodizing

Better Quality Plating

Saves LABOR, Material and Steam

Helps Eliminate Rejects

MOST VERSATILE REGULATOR for METAL FINISHING PROCESSES

Repays Its Cost 3 to 6 Times a Year

POWERS **NEW No. 11-MF Self-Operating Temperature REGULATOR**

Will help you get the most effective use from chemical solutions in plating, anodizing, bonderizing, cleaning, pickling and rinse tanks.

Eliminate "the human element" in temperature control with Powers automatic Regulators. They're simple, compact and dependable. They stop OVER-heating, prevent waste of steam, water wasted by evaporation, burnt plated parts, rejected anodizing, decomposition of costly additives and loss of volatile ingredients from some cleaning solutions.

Powers Regulators require no electricity, are available in several temperature ranges and valve sizes with heavy duty double union bronze body and valve stem lubricator.

Plastic Covered Thermal Bulb and Tubing are highly resistant to metal finishing solutions. Prevents electrical shorts. No insulators are required for the regulator.

Easy to read 4" Dial Thermometer indicates temperature of solution under control. It gives a visual check of the process and makes it easy to adjust regulator for different temperatures.

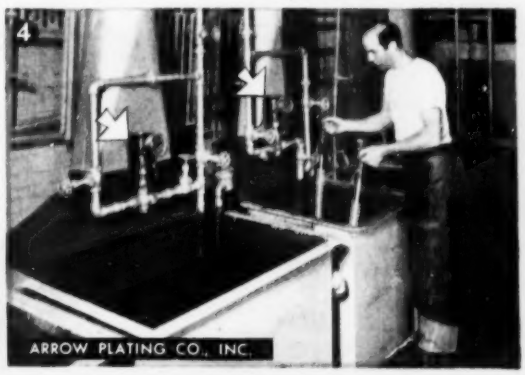
Write for Bulletin 330. If you want to try a Powers No. 11-MF Regulator contact our nearest office or write us direct.

Prompt Delivery from Stocks in Leading Plating Centers.

Established in 1891 • THE POWERS REGULATOR COMPANY • SKOKIE, ILL. • Offices in Over 50 Cities
in the U.S.A., CANADA and MEXICO • See Your Phone Book

(b33)

BELMONT PLATING WORKS, INC.



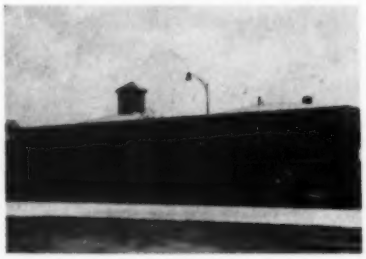
ARROW PLATING CO., INC.

Industry News

lenium rectifiers and maintain a full inventory.

Industrial Filter Completing Expansion Program. To meet the ever-growing demand for its products, the Industrial Filter & Pump Manufacturing Co., 5900 W. Ogden Ave., Chicago 50, Ill., is completing its third expansion program in the last six years. Included in the present program is a plant addition of 15,000 square feet and new equipment.

Supplementing these enlarged manufacturing facilities is a new research and development department that will work on improvements in the design and performance of the company's products, and on new applications, also on the development of new products and services that will be announced and offered as soon as perfected.



A new experimental laboratory has been outfitted and staffed to study coagulation rates, treatment of industrial wastes, the conditioning of industrial process water, and ion exchange applications.

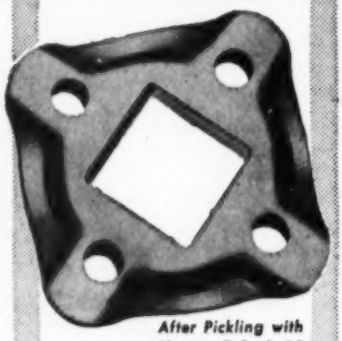
EKH Scholarship Winner Selected. The Joseph B. Kushner Electroplating School of Stroudsburg, Pa., announces that Kenneth Hampel, of Grand Rapids, Mich., has been awarded a scholarship in Electroplating Know How, the correspondence course in modern electroplating. Hampel's entry in the "What I Like and Dislike About the Electroplating Industry" essay contest was selected as best by the judges, on the basis of sincerity and constructiveness of thought. The Board of Judges, who selected the winning entry, consisted of Ezra Blount, Editor of PRODUCTS FINISHING, Nat Hall, Editor of METAL FINISHING, and Al Korbelak, Editor of PLATING.

Hampel

Hampel is a research plating chemist for the Jervis Corporation where he does research and trouble shooting on production plating problems. He has been associated with the electroplating and metal finishing industry since 1938 when he received his B.S. in chemistry from Michigan State College. In 1941 he became a member of the AES Grand Rapids Branch and has held several branch offices. At present he is Branch Secretary. He has two metal finishing patents to his credit.

Acid for De-Scaling and Rust Removal ...of Course! BUT MAKE IT A *Safe* ACID!

Before Pickling



After Pickling with Magnus D-Scale-RS

Use a material that:

- Stays inert until dissolved in water.
- Attacks only scale and rust.
- Does not "over-pickle."
- Is safe in handling and in storage.
- Does a sure, dependable pickling job.
- Can be used hot or cold, in tumbling barrels, as well as in tanks.

USE MAGNUS D-SCALE-RS

Write for Bulletin 36 for the whole story on fumeless high-speed de-scaling and de-rusting.

magnus

MAGNUS CHEMICAL CO., INC.
41 South Ave., Garwood, N. J.
In Canada: Magnus Chemicals, Ltd., Montreal
Service Representatives in Principal Cities

SALESMAN WANTED

Old established manufacturer of complete line of Electroplating and Polishing Equipment and Supplies desires salesman for Chicago and Midwest territory. Excellent opportunity for right man. State age, experience and salary expected. *Reply to:*

P-354-A, PLATING
445 Broad St., Newark 2, N. J.

Assistant Director of Research, 30-35, for international electroplating corporation. Must have at least 5 years research and development experience in electro or inorganic chemistry. Give full details of background, experience, and salary expectations in first letter. Location small city western New York. Salary open. *Reply to:*

P-354-B, PLATING
445 Broad St., Newark 2, N. J.

SUPERTARTRAL, in competition with Rochelle Salts or Potassium Tartrate and used in connection with *any* cyanide copper plating operation, offers the following:

- **SUPERIOR** Anode Corrosion, making maximum use of plating metal.
- **SUPERIOR** Solution tolerance to numerous metallic impurities such as Chromium, Calcium, Barium, Magnesium, etc.
- **SUPERIOR** Deposits with less tendency for roughness, caused by metallic impurities such as might be introduced with hard water.
- **SUPERIOR** Cost Savings when used at recommended concentration; where operating characteristics of standard and bright baths utilize Rochelle Salts at 6 oz./gal., SUPERTARTRAL offers 20% savings over Rochelle Salts and 23% saving over Potassium Tartrate.
- **SUPERIOR** Cyanide Stability... Lea-Ronal SUPERTARTRAL reduces cyanide breakdown with its resultant carbonate formation.

SUPERTARTRAL has been thoroughly and successfully *production* tested in still tank and barrel installations of conventional and bright cyanide copper processes, including the widely used Lea-Ronal Bright Copper Process.

LEA-RONAL Products are the result of careful research and development which guarantees that they are not put on the market until ready.

Don't you think that your constant search for improving plating operations and for lowering costs, warrants thorough investigation and trial of LEA-RONAL SUPERTARTRAL?

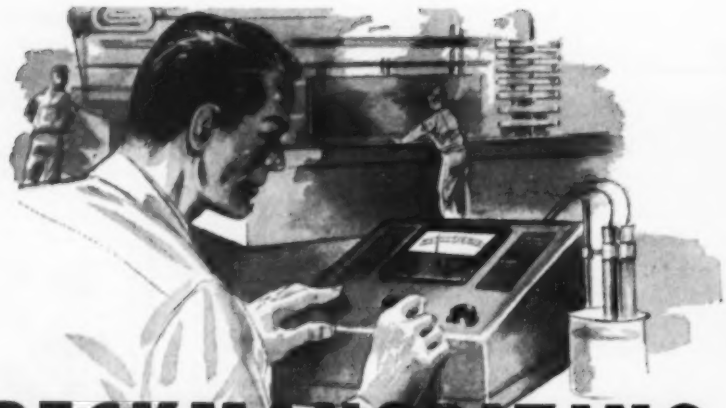
*Trade Mark Applied for
Patents and Patent Pending

The LEA GROUP
serving the Finishing Field
LEA-RONAL, INC.
The Lea Mfg. Co., Waterbury, Conn.
Lea-Michigan, Inc., Detroit
Lea Mfg. Co., of Canada, Toronto
Plating Polishing Buffing
Burring

Lea-Ronal Inc.

Main Office and Laboratory
42-46 27th Street, Long Island City 1, N. Y.

Manufacturing Plant
227 East Aurora Street, Waterbury 20, Conn.



BECKMANODIZING

the new term in plating plants everywhere for accurate pH controlled ANODIZING!

Solve your troublesome anodizing problems once and for all by using BECKMAN pH Control—a "must" in anodizing aluminum by the sulfuric acid or chromic acid methods where careful pH ranges have to be maintained. By far the fastest, simplest—and in the long run—cheapest way to measure pH accurately is with Beckman Glass Electrode pH Meters. Because Beckman pH Equipment does the job better for less—because Beckman has been responsible for nearly all major advances in this field—you owe it to yourself to investigate how BECKMAN can untangle your production snarls and cut costs.

"Beckman pH Instrumentation is absolutely essential for close control in anodizing!", says Crown City Plating Company. For full details, see your Beckman Dealer, or write for Data File 62-72

GENERAL PURPOSE — Beckman Model H-2 pH Meter. A line operated "workhorse" designed for plug-in convenience on 115 v AC circuits and 24-hour duty. Permits instant measurements without turning on and adjusting instrument.

PORTABLE — Beckman Model N pH Meter. This compact, easily carried traveling laboratory contains everything you need for making pH measurements around your plant. Low price, light weight, battery-operated. Accuracy within 0.03 pH.

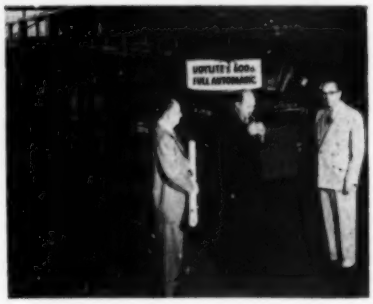
Beckman *division*

BECKMAN INSTRUMENTS, INC.
SOUTH PASADENA 1, CALIFORNIA

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 309.

Industry News

Udylite's 600th Full Automatic Plating Machine. Holder of many "firsts" for plating industry inventions, The Udylite Corporation now is breaking records in sales and production, as shown here by its 600th full automatic plating machine.



John V. Davis, chief engineer, who designed the machine (left), and Clyde H. Reeme, president, look on as Lawrence V. Nagle, executive vice-president, illustrates the purpose of the machine by using a plated Zippo cigarette lighter

This machine was built to copper-nickel-chromium-plate steel and brass lighter cases for the Zippo Manufacturing Co. of Bradford, Pa. It is 99 feet in length and has 35 stations for processing.

Buffing & Tumbling Supplies Company Formed. The Gerell Mfg. Co. announces the establishment of the Stanley Supply Co. for the distribution and sales of buffing and tumbling supplies. New and enlarged plant, warehouse and offices are located at 5208 Sweeney Ave., Cleveland 27, Ohio.

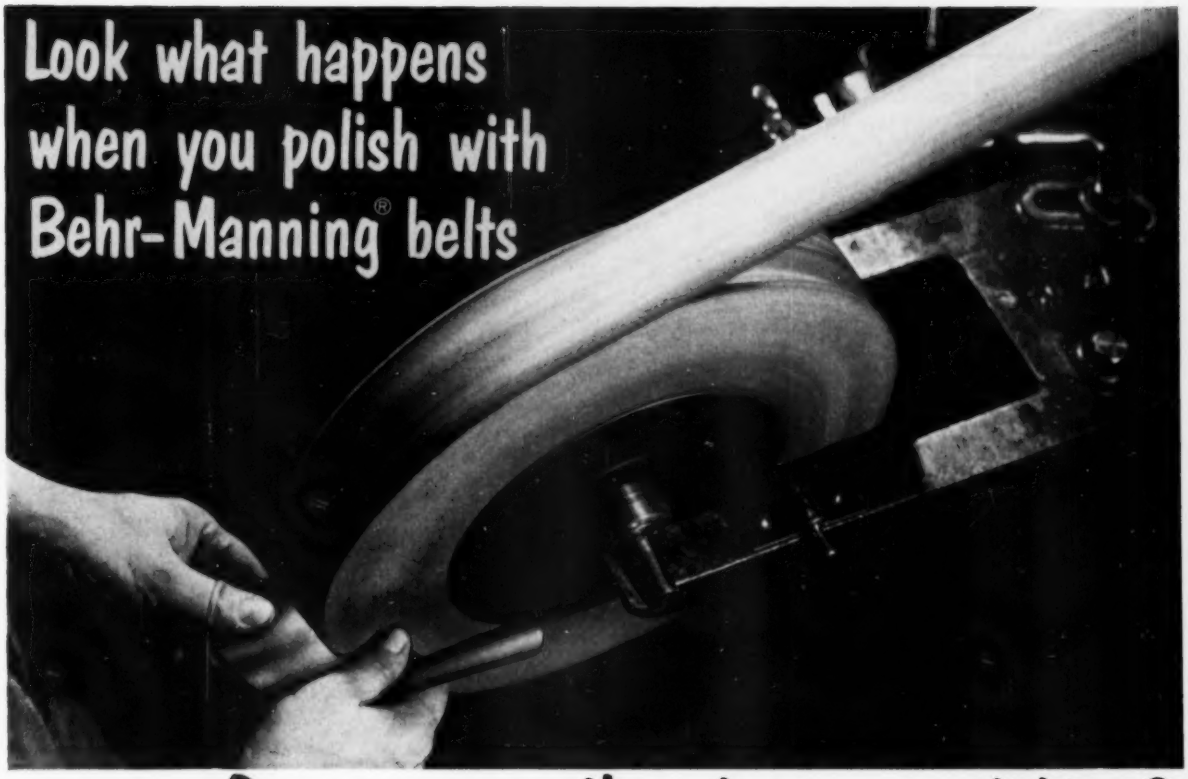
Pennsalt Consolidates Personnel and Public Relations Activities. The Pennsylvania Salt Manufacturing Company has announced the consolidation of its personnel and public relations activities under the direction of Fred C. Abbott, Manager of Personnel and Labor Rela-

INDUSTRIAL SALES OPPORTUNITY

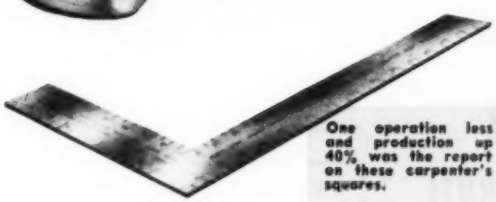
Manufacturer of nationally advertised industrial parts cleaning equipment seeks financially responsible firm to handle complete line in Southwestern territory. Attractive commission arrangement. Send complete resume of qualifications and experience. Interview arranged at your convenience. *Reply to:*

P-354-C, PLATING
445 Broad St., Newark 2, N. J.

Look what happens when you polish with Behr-Manning® belts



More production at less cost was the story of finer finish on golf club irons.



One operation less and production up 40% was the report on these carpenter's squares.

Finishing O. D. surfaces of fountain pen barrels was converted to automatic feed.

How about your polishing?

Flexible, evenly-coated BEHR-MANNING Abrasive Belts can polish your toughest contours, produce superior finishes and slash production time. Bring your parts to a nearby BEHR-MANNING Demonstration Room and see for yourself. Make a date now. Behr-Manning Corp., Troy, N. Y., Dept. PL-3.

In Canada: Behr-Manning (Canada) Ltd., Brantford.
For Export: Norton Behr-Manning Overseas Inc., New Rochelle, N. Y., U. S. A.

BEHR-MANNING® CORPORATION division of NORTON Company

▲ COATED ABRASIVES ▲ SHARPENING STONES ▲ PRESSURE-SENSITIVE TAPES

Belt method licked contour polishing on these forged steel wrenches.

Brass plumbing fixtures took plating better after belt finishing was installed.

Roughing and fining out were simplified for these brass hardware fixtures.

Weld marks on bumper guards were quickly roughed and blended with belts.

P-1

For the newest in coated abrasives.. watch BEHR-MANNING

Industry News

tions since 1947. The redesignated office will be known as the office of Industrial Relations. Abbott, a chemical engineer, was graduated from the University of Arkansas and came to Pennsalt in 1943. He attended the advanced management course of Harvard Graduate School of Business Administration in 1950. His staff will serve nine plants and numerous sales offices of the parent company and its three subsidiaries.

Promat Appoints Swift Chemical. The Promat Division of Poor & Co., 851 S. Market St., Waukegan, Ill., has announced the appointment of the Swift Industrial Chemical Co., of Canton, Conn., as eastern sales representative for the Promat line of metal finishing processes.

Swift

The Swift organization has been active in the manufacture and sale of metal finishing, treating, cleaning and descaling compounds since 1949. John A. Swift, president and technical director, a 1928 M.I.T. graduate, has served as assistant works metallurgist for the American Steel and Wire Company and chief metallurgist for the Billings and Spencer Company. He is active currently as chairman of the Hartford Chapter, ASM and chairman, New England Conference, AIMME.

New Quarters for Nox-Rust Chemical Corporation. Nox-Rust has moved to brand-new quarters with executive offices at 333 N. Michigan Ave., Chicago 1, Ill., and manufacturing research and quality control facilities at 4700 S. Central Ave., Chicago 38, Ill.

H-VW-M President honored on 25th Anniversary. At a recent dinner at the University Club in New York, Louis M. Hague, President of Hanson-Van Winkle-Munning Co., Matawan, N. J., was presented with a gold watch by his fellow directors and a pair of silver candelabra by the corporation in commemoration of 25 years with the firm. The presentation was made by Mr. Van Winkle Todd, Chairman of the Board

Brand New!

FOR BETTER BUFFING

The Nankervis Air-Operated Automatic Compound Applicator

X STROKES PER MINUTE

(X — The number of strokes your buffing operation calls for— indexed by work, platen, electric timer, foot switch, cam, etc.)

You, too, can cash in on all of the advantages of automatic compound application—earn substantial savings in material and time, have a cleaner buffing department as well.

The Nankervis air-operated automatic compound applicator provides all of these advantages and more!

Because it is flexible, you use compound only when it's needed. The number of times the compound actually touches the wheel depends upon the buffing operation involved. *That, alone, adds up to real savings.* The applicator is actuated either mechanically, electrically or manually; feeds just the right amount of compound; not too much, not too little.

It's ideal for multiple operation, too. All the applicators on an entire buffing line can be operated simultaneously from a single three-way valve.

The entire story is contained in the new Nankervis booklet covering the air-operated compound applicator. Write for Bulletin No. 6-600—*today!*

Nankervis Company

EQUIPMENT AND SUPPLIES FOR THE METAL FINISHING INDUSTRY

19255 WEST DAVISON AVENUE • DETROIT 23, MICHIGAN

PRODUCTION SUPERVISOR
for
EASTERN PLATING PLANT

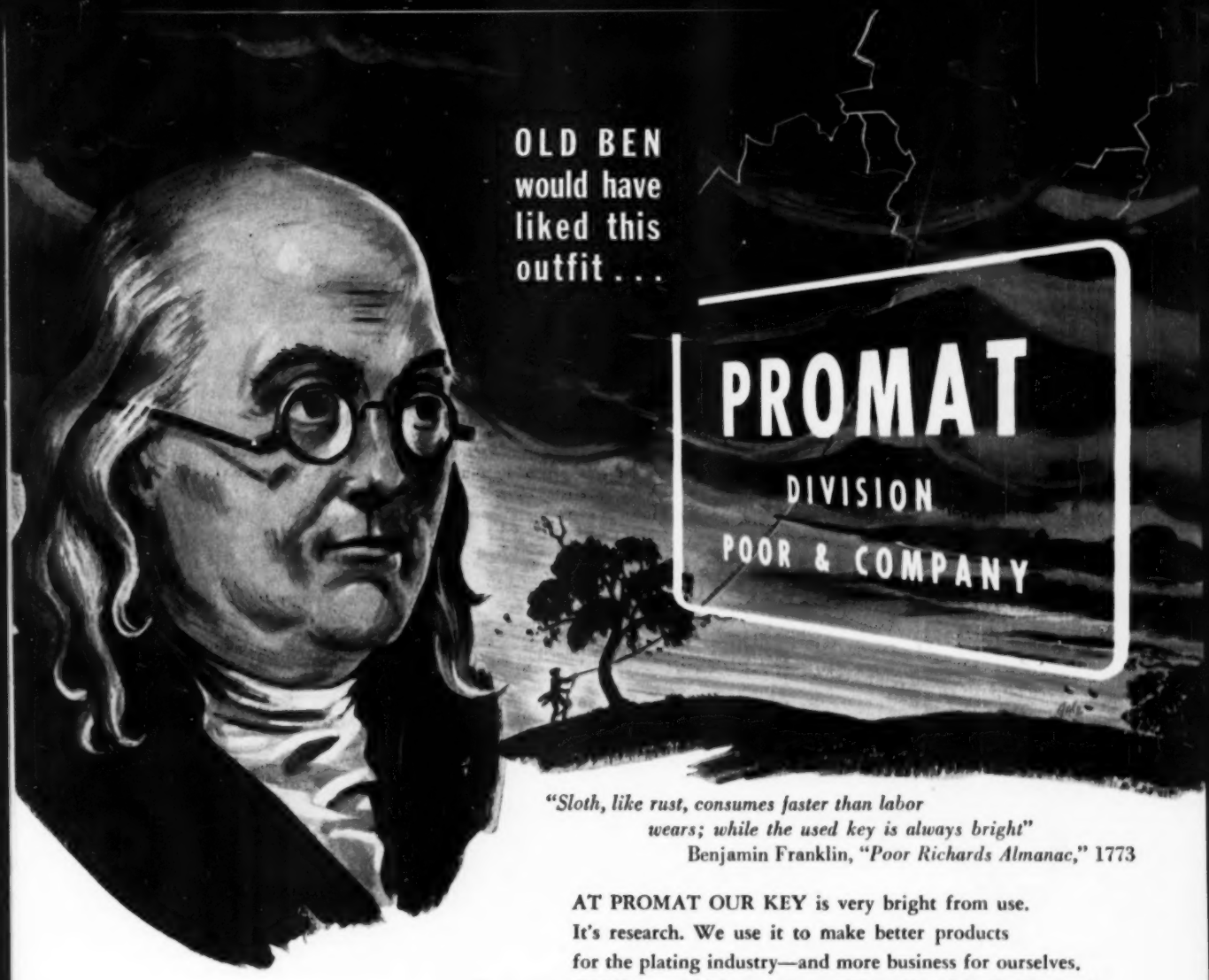
SITUATIONS OPEN—Looking for a man with a good knowledge of Plating. Who is a good Supervisor and Production wise. Excellent salary. *Reply to:*

P-354-D, PLATING
445 Broad St., Newark 2, N. J.

WANTED
BUFFING COMPOUND CHEMIST

Chemist wanted with at least 5 years experience in manufacturing buffing and polishing compounds. Must know abrasives, greases and kindred raw materials. Exceptional Opportunity in Profit Sharing Plan. We are well established in our industry. *Write:*

P-354-E, PLATING
445 Broad St., Newark 2, N. J.



"Sloth, like rust, consumes faster than labor wears; while the used key is always bright"
Benjamin Franklin, "*Poor Richards Almanac*," 1773

AT PROMAT OUR KEY is very bright from use. It's research. We use it to make better products for the plating industry—and more business for ourselves. Old Ben would have approved heartily of both the method and the motive.

Like Ben, we've flown a kite, or two, into the unknown with pretty fine results—a zinc electrolyte, Promat 99M2X, that's the easiest handling available; Probrite White Alloy, a new finish and a badly needed, tested alternate for nickel. We spent seven years developing what we think are the most effective protective films for zinc-cadmium, aluminum and magnesium. These are just a few typical Promat research developments.

We've grown because, like "Poor Richard," we believe, "by diligence shall we do more with less perplexity . . . God gives all things to industry."

PREPARATION: **addition agents • iron sequestering agents • foamers**

PLATING: **acid and alkaline zinc baths • cadmium baths • cyanide copper plating processes • Probrite White Alloy • Buffing grade Probrite**

PROTECTION: **chromate films for zinc, cadmium, aluminum and magnesium**

WHAT'S YOUR PROBLEM?...
Just drop us a line for special bulletins on any of the above.

PROMAT

DIVISION
POOR & COMPANY

851 S. MARKET STREET
WAUKEGAN, ILLINOIS

INDICATE A 312.

Industry News

Diamond Alkali Organizational Changes. Diamond Alkali Company has announced three major organizational changes: establishment of a Chlorinated Products Division, establishment of a Plastics Division, and appointment of a new works manager at the company's Houston, Texas plant.

Diamond Alkali vice president A. L. Geisinger has been named general manager of the new Plastics Division.

C. E. Lyon, also a vice-president, has been named general manager of the new Chlorinated Products Division.

Frank Chrencik has been promoted to succeed Lyon as works manager of the Houston plant. He has been assistant works manager there for the past six years, and was previously superintendent of Diamond's Edgewood, Md., electrochemical plant.

National Research Corp. Division Consolidated. All functions and departments of the equipment division of National Research Corporation now are located at the division's manufacturing plant at 160 Charlemont St., Newton Highlands 61, Mass. By thus bringing sales, engineering, product development, and manufacturing activities together at one location, more efficient operations and better customer service will be possible.

The NRC Equipment Division specializes in high vacuum equipment, including diffusion and mechanical vacuum pumps, vacuum gauges, coaters, furnaces, and other high-vacuum process equipment.

New D-Men, field service representatives of The Diversey Corporation, who have just completed an intensive technical and sales training course and are now in the field selling Diversey's prefinishing cleaners to the Metal Industries. Back Row (l. to r.): W. O. Schmidt, J. O. Hillock, Jr., R. S. Sweeney, A. J. Babinski, W. G. Polzin, P. L. Moltzau, R. W. Dinsmore. Front Row (l. to r.): J. H. Palmer, assistant to the manager; R. L. Shannon, manager of the Metal Industries Department; R. R. Seelye, instructor

High Speed Continuous Gas Plating. Commonwealth Engineering of Dayton, Ohio, announced that it has received recently revolutionary new patents on gas plating, on a method of plating wire continuously, a method of plating rolled sheets and strip continuously, and a method of continuously coating metal castings and simultaneous continuous gas plating. These three patents are Nos. 2,656,283, 2,656,284, and 2,657,457.

These patents constitute a group for high speed continuous gas plating without the disadvantages of hydrogen embrittlement of metal and without the necessity of any separate source of heat in connection with the deposit of the metals from the metal carbonyls.

New Firm Serving Platers. A new Corporation, the G. S. Equipment Company, 5317 St. Clair Ave., Cleveland, Ohio, has been organized to serve the metal finishing industry with new equipment of its own design and manufacture as well as other national makes.

It was organized by the officers and

after the first call we generally have a steady customer for our

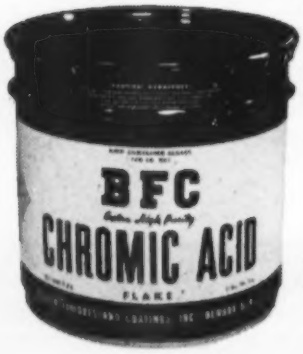
EXTRA HIGH QUALITY 99.7+% PURE

CHROMIC ACID

TECHNICAL GRADE—FLAKE

Only a few years ago we were new comers to the Chromic Acid business. Since then we've shipped quite a few million pounds . . . and made a lot of good friends, too.

We think you will like the quality of our products and the fair way we do business. Why not send us a modest order and judge for yourself? That's the simple way our present customers got started with BFC Chromic Acid.



BETTER FINISHES & COATINGS, INC.

268 Doremus Avenue, Newark 5, N. J.
122 East 7th St., Los Angeles 14, Calif.

PAINTS PLASTICS CHEMICALS BFC

WANTED

Sales representative to handle established accounts and develop new business for large manufacturer of corrosion resistant pipe. Must have good metallurgical background or training in welding stainless or clad steels. Excellent opportunity for man presently associated with the field who is free to travel. Salary open. Our employees know of this advertisement.

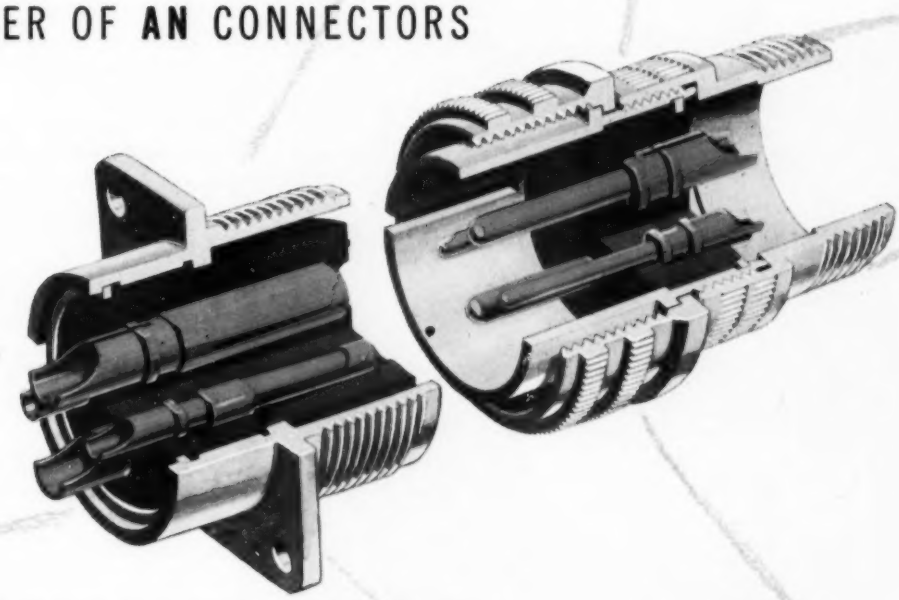
Reply to:

P-354-F, PLATING
445 Broad St., Newark 2, N. J.

Sel-Rex®

BRIGHT GOLD PROCESS

NOW USED BY THE NATION'S LARGEST PRODUCER OF AN CONNECTORS



Simplicity of operation... uniform, high quality performance... characteristics that cannot be achieved with any other gold plating process—these are just a few of the reasons why American Phenolic Corp. uses the Sel-Rex BRIGHT GOLD PROCESS to electroplate high quality AMPHENOL AN Connector contacts.

Packaged in 1, 5 and 10 ounce bottles

Here are the advantages of plating electrical contact surfaces with the Sel-Rex BRIGHT GOLD PROCESS:

LONGER LIFE—the extreme hardness of the deposit, twice that of conventional gold plating, resists wear and abrasion, even on sliding or wiping contacts.

IMPROVED PERFORMANCE – the smooth, fine grained deposit assures a superior contact surface, both electrically and mechanically.

GREATER ECONOMY—uniform metal distribution, even in deep recesses and interior surfaces, gives greater protection with less gold. The solution operates at room temperature and is simple to maintain.

BETTER APPEARANCE—the mirror-like finish will not corrode or oxidize – each part maintains a like-new appearance and has indefinite stock life.

SEL-REX PRECIOUS METALS, INC.

Dept. PL 3 229 Main Street • Belleville 9, N. J.

☐ Mail literature and complete technical data on *SEL-REX BRIGHT GOLD PROCESS.*

☐ Mail information on *SEL-REX* Silver Sol-U-Salt, Gold and Rhodium.

☐ I would like to have one of my products gold plated by the *SEL-REX BRIGHT GOLD PROCESS* as a test. Kindly let me have particulars as to how this can be arranged. A description of my product is enclosed.

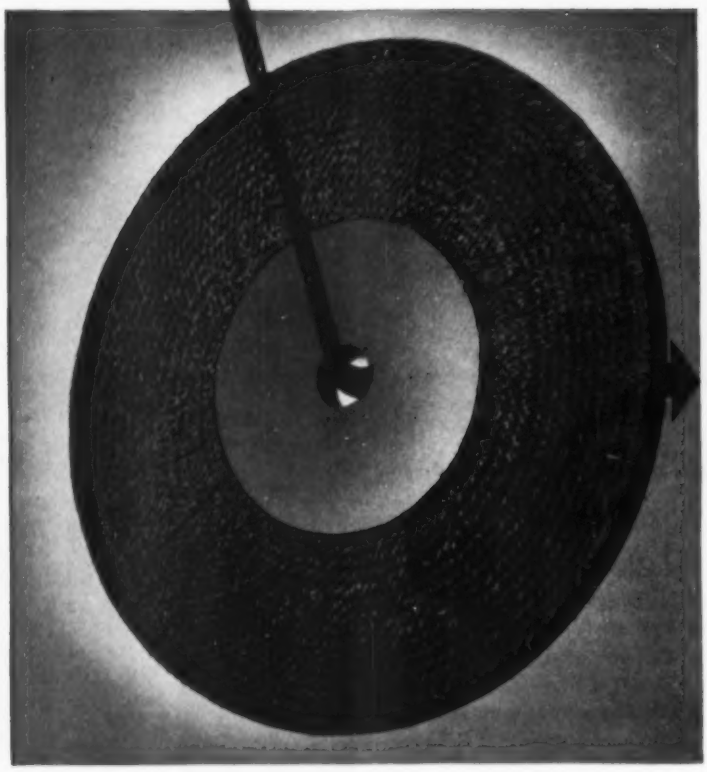
*Name*_____

*Company*_____

*Address*_____

*City*_____ *Zone*____ *State*_____

NON-FRAY *Blu-sisal* BUFFS



In order to eliminate the principal disadvantages prevalent in ordinary sisal buffs, CODMAN has developed a treated sisal known as BLU-SISAL.

The principal features of BLU-SISAL BUFFS are:

1. Blu-Sisal Buffs are treated for hardness to increase cutting qualities.
2. Blu-Sisal Buffs are treated in such a manner that the sisal fibres are bound together to eliminate excessive fraying.
3. And most important the Blu-Sisal Buffs are treated so that they hold compound.

Codman Blu-Sisal non-fray buffs are available from ten inches up. Ventilated if necessary.

Codman Blu-Sisal Conventional Buffs are available in all diameters.

F.L.&J.C. CODMAN CO.

ROCKLAND, MASSACHUSETTS.

For over a half century, the Codman Company has been producing a most complete line of buffs and polishing wheels. During this period, Codman has pioneered in the development of products to meet the exacting needs of the metal finishing industry. This program has been possible because the efforts of the Company have been devoted **exclusively** to the design development and manufacturing of buffs and polishing wheels.

BRANCH OFFICES:

PHILADELPHIA · DETROIT · LOS ANGELES · GRAND RAPIDS

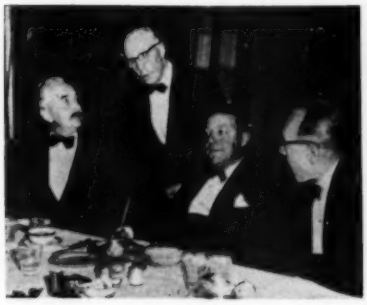
directors of the General Supply Company, same address, and will take over all equipment sales formerly handled by that firm. The General Supply Company continues to serve the metal finishing industry with supplies only.

Kraft Chemical-Dornoff Merger. In line with the program of departmentalizing their operations, Kraft Chemical Company announces the merger of Edward R. Dornoff Company with Kraft Chemical Company. The Edward R. Dornoff Company are sales agents handling raw materials for the paint, paper and adhesive industries. Edward Dornoff will head the newly created protective-coating sales division.

In coming to Kraft Chemical Company, Mr. Dornoff brings with him over twenty years of experience in the application of raw materials in this field. He is especially well versed in resins and latices used in these industries.

Prior to his operation as a manufacturer's agent, Dornoff was with Montgomery Ward & Company. He served them in various buying capacities, the last four years as purchasing agent at Ward's Paint Manufacturing Division.

Dornoff was born in Washington, D. C. He attended the public schools and George Washington University in Washington.



Honor W. J. Cluff. A group of business associates recently honored W. Joseph Cluff, president of the Frederic B. Stevens, Inc., (center), on his 70th birthday at a party in the Detroit Athletic Club. With him are (left to right) John D. Scofield, Udylite Corporation lawyer and a director; Arnold F. Malow, president of Barton-Malow, construction company; and Clyde H. Reeme, president of Udylite. A "This Is Your Life" transcription and slide film presentation traced Cluff's active business and civic career from birth on through his long association with the Stevens firm, now a subsidiary of the Udylite Corporation. Cluff has been with Stevens for more than 50 years

a special message for manufacturers of military equipment
need a finish to beat these specs?
specify IRIDITE
AN-C-170 MIL-S5002 MIL-C-5541 AN-P32
AMS-2402A USA-50-80-11A J.Q.D. No. 144B
USA 57-93-2A O.S. No. 1374 USA 57-0-2C AN-P61
A-XS-1607 QQ-P-416 QQ-Z-325 MIL-3151 —
if you're finishing under these or similar specifications, here's how you can use Iridite:
ON ZINC AND CADMIUM you can get highly corrosion resistant finishes to meet any military or civilian specifications and ranging in appearance from olive drab through sparkling bright and dyed colors.
ON COPPER . . . Iridite brightens copper, keeps it tarnish-free; also lets you drastically cut the cost of copper-chrome plating by reducing the need for buffing.
ON ALUMINUM Iridite gives you a choice of natural aluminum, a golden yellow or dye colored finishes. No special racks. No high temperatures. No long immersion. Process in bulk.
ON MAGNESIUM Iridite provides a highly protective film in deepening shades of brown. No boiling, elaborate cleaning or long immersions.
AND IRIDITE IS EASY TO APPLY. Goes on at room temperature by dip, brush or spray. No electrolysis. No special equipment. No exhausts. No specially trained operators. Single dip for basic coatings. Double dip for dye colors. The protective Iridite coating is not a superimposed film, cannot flake, chip or peel.
WANT TO KNOW MORE? We'll gladly treat samples or send you complete data. Write direct or call in your Iridite Field Engineer. He's listed under "Plating Supplies" in your classified telephone book.
ALLIED RESEARCH PRODUCTS
INCORPORATED
4004 06 E. MONUMENT STREET • BALTIMORE 5, MD

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 316.

Personals

Matthew H. Conway has been appointed to the post of Mechanical Engineer by the Chandeysson Electric Co., St. Louis.

During the past nine years, Conway has served as drafting supervisor and engineer for the company. Prior to his connection with Chandeysson, he was in charge, successively, of the drafting department, tool design department, production control department, and mechnical design department of a St. Louis shoe machinery company.

Joseph J. Cizas has been named field sales representative for the southwestern territory of Missouri, Texas, Kansas, Arkansas and Louisiana by the Hanson-Van Winkle-Munning Co.

H-VW-M will continue its distributors

Cizas

in these states, with Cizas supplementing their coverage from his office in St. Louis.

A graduate of Bowling Green State University, Ohio, Cizas received his B.S. degree in chemistry in 1949. He has also done graduate work in chemistry at New York University. He joined H-VW-M in May, 1953.

Jack M. Esten has been appointed an abrasive engineer, and **Robert C. Divoll** has been named a field engineer by the Norton Co., Worcester, Mass.

Esten

Divoll

Esten will be responsible for the territory which includes North Carolina, South Carolina, Virginia, and part of Tennessee. After graduation from Worcester Polytechnic Institute in 1951, he was a foreman in the Wire Mills Division of John A. Roebling's Sons of Trenton, N. J.

Divoll will work out of the Pittsburgh District office. He is a 1950 graduate of Clark University and joined Norton following Army service.

John S. Cort, Jr., was appointed sales manager of Diamond Alkali Company's Chromium Chemicals Division according to a recent announcement.

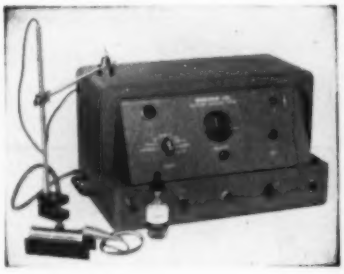
Cort succeeds **Charles E. Grant,** divisional sales manager since 1948, who has resigned to join Butler Manufacturing Company, Kansas City, Mo., steel fabricators.

Cort comes to his new post at Diamond's national headquarters in Cleveland from Kearny, N. J., where he has been assistant manager of the company's chromium chemicals plant for the past five years. Previously, he had been identified with the operations of Diamond's silicate plant at Cincinnati.

Cort graduated from the University of Michigan in 1935, joined the Pennsylvania Salt Manufacturing Co. at its Natrona (Pa.) plant and was subsequently

test the thickness of plating . . .

- **Quickly**
- **Accurately**
- **Simply**



with the KOCOUR Electronic Thickness Tester

It's no longer necessary to spend many hours of laboratory time to determine the thickness of plating. You can test the thickness of all the commonly deposited metals on various base metals and materials in approximately a minute with an accuracy of 90–95%. No highly skilled technicians are required to operate the instrument because . . . operation is virtually automatic . . . readings are direct . . . no calculations, no graphs, no charts, no standards to contend with.

The **KOCOUR ELECTRONIC THICKNESS TESTER** is being used to make thousands of thickness tests daily. Companies ranging from the small job shops to large industrials are solving hundreds of thickness testing problems daily with the consistently accurate results they can depend on.

Investigate today! See how the Kocour Electronic Thickness Tester can solve your problems. We guarantee satisfaction.

Write for literature. No cost . . . no obligation.

KOCOUR COMPANY

4801 S. St. Louis Ave.
Chicago 32, Illinois

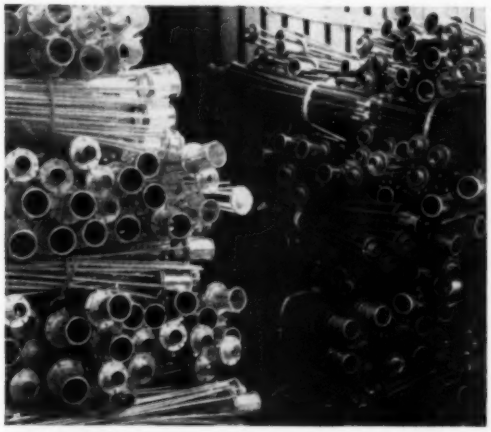
• Pioneers & Specialists in Test Sets & Instruments for the electroplating industry since 1923.

Specify KOCOUR TEST SETS from your supplier.

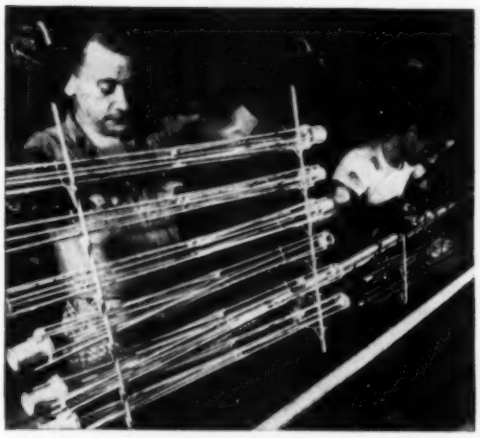
PLATING SUPERVISOR

Old established Plating Company has new building, new excellent equipment and is looking for a new man to take charge. A real job for a man of ability. This man is probably now employed, and would consider a change for the better. Replies confidential. Satisfactory arrangements will be made for interview in Philadelphia. Mr. J. L. Nelson, Standard Plating Works, Inc., "B" St. and Olney Ave., Philadelphia 20, Pa.

"No operating troubles in 27 years of plating with Du Pont 'Cadalyte' plating materials"



One of North Side's important jobs is plating frames for beach umbrellas. The raw, unfinished frames on the right have just arrived from the manufacturer. Those on the left show the bright, uniform deposits obtained directly from the "Cadalyte" bath.



Workman removes beach umbrella frames from the bath after plating. (The man in the background is lowering unplated frames into the bath.) A "Cadalyte" bath is easily operated and maintained . . . has excellent throwing power and high cathode efficiency.

says **MAX WEISS,**
co-owner of
North Side Plating
and Polishing Works,
Brooklyn, N. Y.

"WE TURN OUT AS MUCH AS 200,000 POUNDS OF WORK PER DAY," continues Mr. Weiss. "In 1927 my partner, Mr. Benjamin Glick, and I started using 'Cadalyte' plating salts, and we're still using them. The process is simple and fast . . . it's never given us a single operating problem. And we get good, bright cadmium plate over almost any kind of metal surface."

A pioneer in cadmium plating, North Side is probably the largest job plater in the Eastern United States. It handles job work on everything from television antennas to army and navy equipment. Twelve tanks, each holding 1500 gallons of plating solution, provide a daily plating capacity of up to 96 tons. In addition there are 41 barrel platers, each capable of plating about a ton of small parts per day.

"CADALYTE" IS THE *COMPLETE* PLATING SALT, containing all the chemicals needed for uniform lustrous deposits of any specified thickness. North Side is only one of hundreds of firms that find it ideal for their plating needs . . . and that benefit from Du Pont service. Our experienced technicians will be glad to help you with any plating problems. Just get in touch with our nearest district office. And for further information and literature, send the coupon below.

DISTRICT OFFICES:
Boston • Charlotte • Chicago • Cincinnati • Cleveland • Detroit • El Monte (Calif.) • Kansas City* • New York • Philadelphia *BARADA & PAGE, INC.

Chemicals • Processes • Service
for **ELECTROPLATING**
DU PONT
REG. U.S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

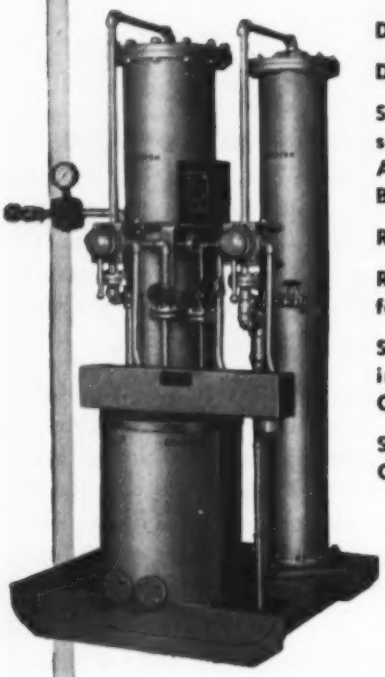
E. I. du Pont de Nemours & Co. (Inc.)
Electrochemicals Dept., P-34, Wilmington 98, Del.

Please send me more information on Du Pont Plating Chemicals —properties, advantages and recommended procedures. I am interested in the following types of plating:

☐ Cadmium Plating ☐ Tin Plating
☐ Copper Plating ☐ Zinc Plating

Name _____
Firm _____
Street & No. _____
City _____ *State* _____

PRACTICAL APPLICATIONS OF ION EXCHANGE



Demineralization of Water

Deacidification of Solutions

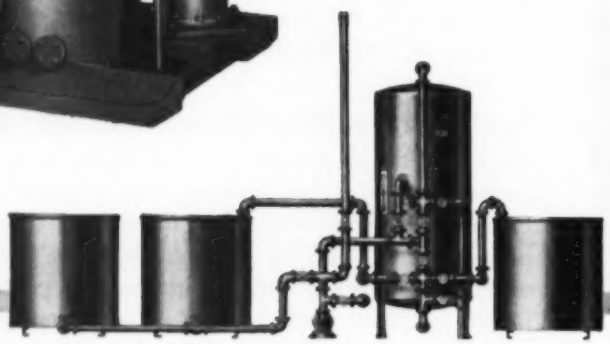
Selective Removal of Troublesome Constituents from Chromic Acid, Plating and Anodizing Baths

Recovery of Valuable Metals

Removal and Recovery of Offending Ions in Waste Waters

Selective Removal of Contaminants from Chromic Acid Copper Stripping Solution

Substitution of Anions and Cations in Solutions



Get Details from INDUSTRIAL

The success stories of ion exchange are not isolated cases. All through industry in a wide variety of applications, ion exchange is effecting substantial cuts in costs, more uniform products, and a new ease in process control.

Here are a few suggestions for you to check against your own processing. INDUSTRIAL is glad to give you the benefit of its experience if you will outline your requirements. An estimate of probable savings, production, approximate costs, and the equipment required will enable you to know what ion exchange can do for you.

4946

INDUSTRIAL

FILTER & PUMP MFG. CO.

5914 Ogden Avenue • Chicago 50, Illinois

PRESSURE FILTERS
DEMINERALIZERS
RUBBER LININGS
HEAT EXCHANGERS
CENTRIFUGAL PUMPS

Personals

engaged in various engineering and production capacities with Garco Products, Inc., Ford City, Pa., Houdry Process Corporation, Paulsboro, N. J., and Diakel Corp., Cincinnati. In 1947, he joined Diamond's Cincinnati silicate plant.

Cort is a member of the American Institute of Chemical Engineers and Phi Sigma Kappa.

Earl Kunish has been appointed to the sales territory embracing Missouri, Iowa, Southern Indiana and Southern Illinois by the Michigan Chrome & Chemical Co., Detroit, Mich.

Kunish

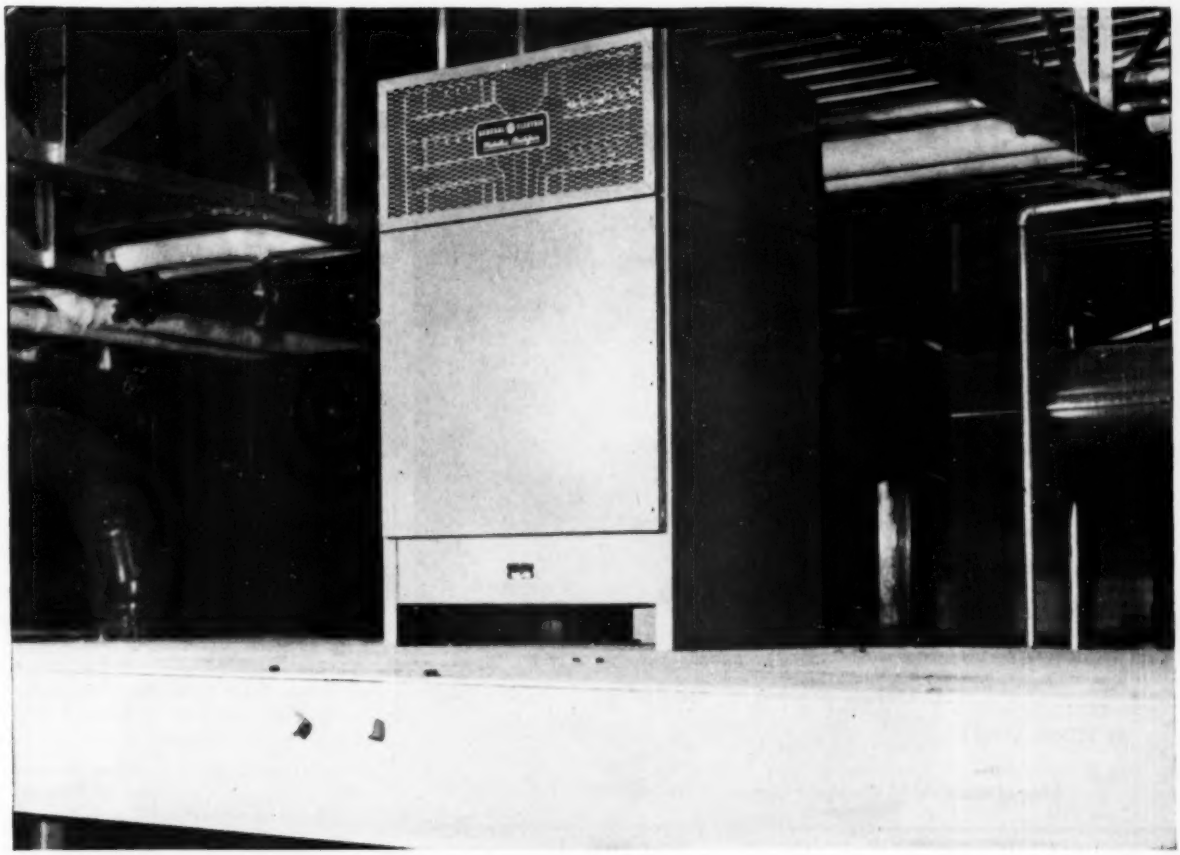
Kunish has had considerable industrial experience as a process engineer at Shellar Engineering and Kaiser-Fraser. After wartime service with the Navy, he spent a number of years as Traffic Manager for Active Tool of Detroit. He will headquarter in St. Louis.

Edward R. Bartos recently joined the sales and service staff of the Detroit office of Wyandotte Chemicals Corporation.

Bartos

A native of Detroit, he majored in chemistry at the University of Detroit and has held technical and sales positions with the Engineering Division of Chrysler Corporation, American Agricultural Chemical Company and the General Controls Company. Bartos has a wide acquaintance in the metal processing industry in Michigan, Ohio and Indiana and is a member of the Detroit branch of the Paint, Varnish and Lacquer Association.

Thornton Q. Raney has been named eastern representative of the Whitfield Chemical Company of Detroit, Mich. Raney will remain located in Philadelphia,



WHEREVER YOU INSTALL THEM...

G-E Plating Power Supplies Save You Money

With General Electric Plating Power Supplies you save on installation, operating, and maintenance costs. Automatic regulation assures uniform quality work and fewer rejects.

SAVINGS — Installation costs are lower because G-E plating rectifiers don't need special foundations—can even be mounted on balconies as shown above.

Operating costs are lower because rectifier stacks are operated at their most efficient ratings. Saturable reactor control of d-c output minimizes power costs.

Only maintenance required is occasional lubrication of the cooling fan, the one moving part. Long life for the equipment is assured by the exceptionally high quality of the G-E rectifiers used.

AUTOMATIC REGULATION can be purchased now or added to manually controlled units at any time in the future. It assures uniform quality work by maintaining constant voltage or current ±2% regardless of tank load or variations in voltages.

FURTHER INFORMATION is available from any of the authorized G-E agents listed, or by writing *Section 464-14, General Electric Company, Schenectady 5, N. Y.*

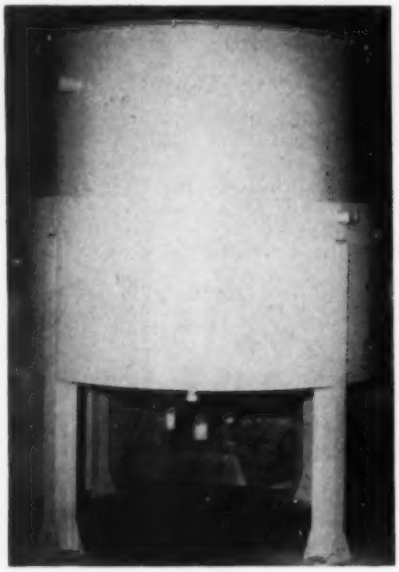
You can put your confidence in—

GENERAL ELECTRIC

G-E PLATING POWER SUPPLIES ARE SOLD BY THESE AUTHORIZED AGENTS:

AMERICAN FACTORS LTD., Honolulu, T. H.
M. E. BAKER CO., Cambridge, Mass.
BELKE MFG. CO., Chicago, Ill.
WILLIAM BUCHANAN SUPPLY CO., Cincinnati, Ohio
THE CHEMICAL CORP. Springfield, Mass.
CLEVELAND ELECTRIC CO., Atlanta, Ga.
CONNECTICUT ELECTRIC EQUIPMENT CO., INC., Meriden, Conn.
ENTHONE CO., New Haven, Conn.
FITZPATRICK ELECTRIC SUPPLY CO., Muskegon, Mich.
W. M. FOTHERINGHAM CO., Buffalo, N. Y.
GENERAL ELECTRIC SUPPLY CO., Cleveland, Ohio
FRED GUMM CHEMICAL CO., Kearny, N. J.
LASALCO, INC., St. Louis, Mo.
LEA MANUFACTURING CO., Waterbury, Conn.
A. J. LYNCH & CO., Los Angeles and San Francisco, Calif.
WILLIAM LYNN CHEMICAL CO., INC., Indianapolis, Ind.
MEAKER CO., Cicero, Ill.
CARL F. MILLER CO., Seattle, Wash.
J. C. MILLER CO., Grand Rapids, Mich.
GEORGE L. NANKERVIS CO., Detroit, Mich.
REYNOLDS-ROBSON SUPPLY CO., Philadelphia, Pa.
STANDARD PROCESS CORP., Chicago, Ill.
STANDARD WHOLESALE SUPPLY CO., Las Vegas, Nev.

Interesting for the tank user



WHEN stock tanks fail to qualify, Storts takes over and fabricates tanks especially to meet your needs—tanks for plating, processing, storage—plain tanks, lined tanks, jacketed tanks—exactly to your specified dimensions—welded with a single standard of high quality—guaranteed to satisfy.

42 STONE STREET — STORTS WELDING COMPANY INCORPORATED — MERIDEN, CONN.

Manufacturers of Welded Fabrications to Specification

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 321.

Chromic Acid

CrO_3

for

- DECORATIVE PLATING
- HARD CHROMIUM PLATE
- ANODIZING ALUMINUM
- CHEMICAL CONVERSION COATINGS
- STRIPPING COPPER
- METAL CLEANING BATHS
- ORGANIC SYNTHESIS
- MANUFACTURE OF CATALYSTS

The Mutual name and trade mark on a Chromic Acid drum guarantee a product with a minimum assay of 99.75% and a sulfate content not exceeding 0.1%. Chromic Acid of that purity may be used with confidence in any of the applications shown here.

SINCE 1845

MUTUAL CHEMICAL COMPANY OF AMERICA

270 MADISON AVENUE • NEW YORK 16 N. Y.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 322.

Personals

with offices in the Land Title Building. He has been a manufacturers' representative in the industrial field for several years.

George W. Egger and **Richard R. Russell** have been named sales engineers by the Udylite Corp., Detroit, Mich.

Egger Russell

Egger has been assigned to the Chicago branch office and will serve the territory of Chicago, Aurora and Elgin, Ill.

He has a bachelor of chemical engineering degree from Ohio State University and formerly was with a chemical firm and an insurance company.

Russell received a B.S. degree in marketing from the University of Detroit. He will headquarter at the Udylite branch office in Atlanta and will contact customers in the South Carolina, North Carolina and eastern Tennessee area.

Neil Petersen, Parker Rust Proof Company technical representative in the Detroit area for the past eight years, has been transferred to the West Coast.

Petersen has worked closely with the automobile manufacturers in Detroit throughout his service with Parker, and brings his extensive experience in this industry to Parker's automotive accounts in the Pacific region.

He will work out of the Maywood, Calif., offices of the company.

W. J. Stoddard has been named district supervisor in the Michigan district for the Metal Processing Department of Pennsylvania Salt Manufacturing Company.

Stoddard will supervise sales and service activities in the Michigan area for Pennsalt metal cleaners, Fosbond phosphate coatings and Fos Process lubricants for cold working.

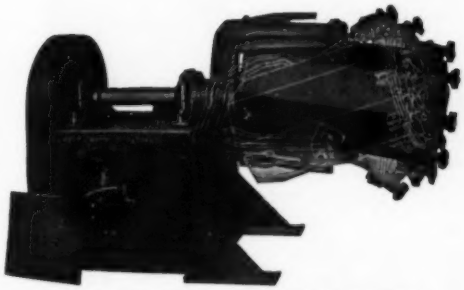
Stoddard, well known in metal working circles in the Detroit area, has a background of 23 years' service with Pennsalt. Prior to joining the metal processing group as a sales-service engineer in 1941, he worked in the laboratory at Pennsalt's Wyandotte, Mich., plant.

USE "RELIANCE" PRODUCTS FOR

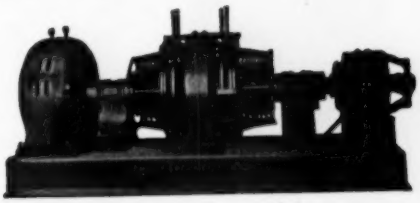
ECONOMY : EFFICIENCY : DEPENDABILITY

LET US SUPPLY YOUR NEEDS FOR YOUR PLATING OR POLISHING DEPARTMENT

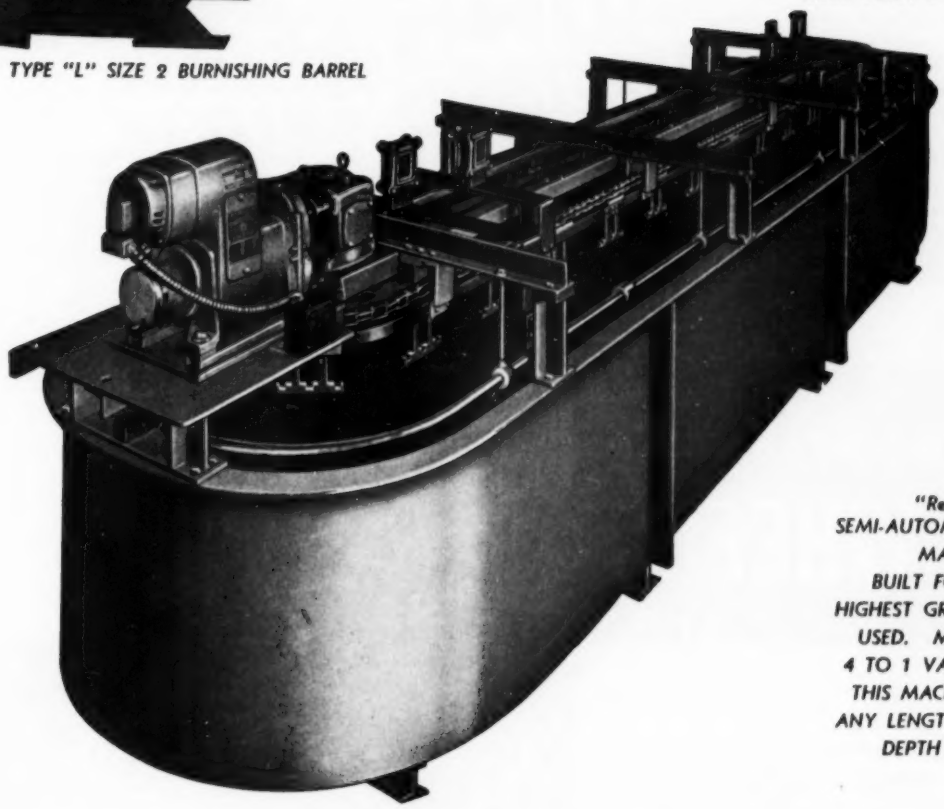
WRITE FOR FURTHER DETAILS



TYPE "L" SIZE 2 BURNISHING BARREL



3000 AMP. 6 VOLT GENERATOR SET



"Reliance"
SEMI-AUTOMATIC PLATING MACHINE
BUILT FOR SERVICE
HIGHEST GRADE MATERIAL USED. MOTOR ½ HP
4 TO 1 VARIABLE SPEED.
THIS MACHINE IS BUILT ANY LENGTH, WIDTH AND DEPTH OF TANK.

Chas. F. L'Hommedieu & Sons Co.

MANUFACTURERS of

Plating and Polishing Machinery

Complete Plating Plants Furnished

Chas. B. Little Co.
Newark, N. J.
W. R. Shields
Detroit, Mich.
Powell Calvert
104 Second Street
Feasterville, Pa.

Gen. Office and Factory:
4521 Ogden Ave.

CHICAGO

Branches:
Cleveland
and
Los Angeles

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 323.

Personals

Eugene L. Combs has been promoted to the position of supervisor of chromic acid sales for Diamond Alkali Co., Cleveland 14, Ohio.

Combs

Well known in the production, engineering, and technical sales and service phases of the electroplating and metal-finishing industries for the past 17 years, Combs joined the Diamond organization in 1950. Since then he has been handling varied assignments in technical service, particularly those related to applications of chromic acid and its use in chromium plating.

From 1942 to 1947, Combs was assistant supervisor in the electrochemical engineering division of Battelle Memorial Institute, Columbus. Previously, he was associated in various production capacities with the Curtiss Wright Corp., Airplane Division, and also with the D. L. Auld Co., Inc.

Combs, an Ohio State University graduate, is a member of the Cleveland Branch, AES. He is Ohio Chairman for the Finance Subcommittee of the Society's Research Committee and is also serving presently as general chairman of the AES National Convention and Fourth Industrial Finishing Exposition to be held in Cleveland in 1955.

Obituaries

✣ **Robert S. Leather,** founder and chairman of the board of the Lea Manufacturing Company, Waterbury, Conn., died suddenly on January 18, 1954. President of the company for many years, Bob Leather, as he was known to a host of friends throughout the finishing division of industry and the metal working field generally, had just left New York with his wife, Laura and friends, for a long Mediterranean pleasure cruise. Three days out he had a sudden heart attack and passed away.

The deceased had been associated with finishing methods and materials since shortly after World War I. He was responsible for developing industry's first greaseless composition for finishing metal surfaces and from this came several successful new finishing methods.

He was one of the original founders and past president of the International Fellow-

Leather

ship Club, now known as the Metal Finishing Suppliers' Association. He was also an honorary lifetime member of the Waterbury Branch of the AES.

✣ **Howard E. Christie,** 62, founder and president of the Christie Plating Company of Groton, Conn., died on January 3, 1954 after an extended illness. He was a member of the New Haven Branch of the AES. In addition to his interest in plating, Christie was a prominent cattle breeder and raised championship stock at his farm in North Stonington.

He is survived by his wife, Vera, two sons, Robert and Richard, and brothers and sisters.

PARAMOUNT BRAND
FELT WHEELS

...TOPS IN "Contourability"

Are you finishing articles which require a wheel with a "shaped" or contoured face? Don't forget that felt wheels lend themselves to contouring probably better than any other type of wheel. Don't forget, too, you have nine degrees of hardness to choose from when you buy Bacon Felt Wheels—The Paramount Brand. Ask your supply house for Paramount Brand Felt Polish Wheels.

Send for Our New Catalog

BACON FELT COMPANY
407 West Water Street
TAUNTON
"America's Oldest Felt Manufacturer"
Established 1825
MASSACHUSETTS
"Felt Does It Better"

Your Supply House can Furnish Bacon PARAMOUNT BRAND FELT BOBS & WHEELS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 324.

In Metal and Alloy Plating

INCREASE OUTPUT! LOWER YOUR COSTS!

with **B&A FLUOBORATE PLATING CHEMICALS**

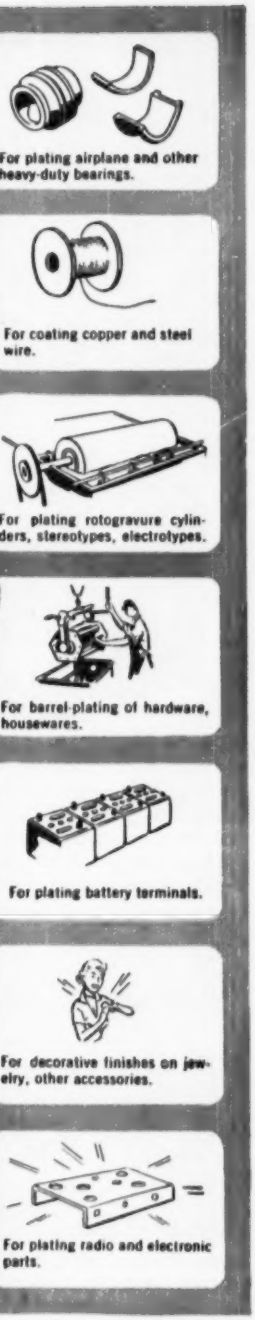
LEAD
TIN
COPPER
NICKEL
IRON

CADMIUM
INDIUM
ANTIMONY*

•

FLUOBORIC ACID

*Experimental Quantities Only


For plating airplane and other heavy-duty bearings.
For coating copper and steel wire.
For plating rotogravure cylinders, stereotypes, electrotypes.
For barrel-plating of hardware, housewares.
For plating battery terminals.
For decorative finishes on jewelry, other accessories.
For plating radio and electronic parts.

Important practical advantages B&A Metal Fluoborates offer you:

- ✓ No mixing or dissolving necessary . . . supplied in concentrated solution form
- ✓ Easier bath preparation
- ✓ Stability of bath composition
- ✓ Ease of control
- ✓ Practically 100% anode and cathode efficiencies
- ✓ High conductivity
- ✓ Fine-grained deposits of good color
- ✓ Good covering power
- ✓ Faster, high-speed operation

AND MANY MORE—

In addition to these general operating advantages, each B&A fluoborate bath has a number of special advantages for its particular applications.

For operating data, experimental or commercial quantities—or for free technical consultation—write or phone the nearest B&A office.

BAKER & ADAMSON *Fine Chemicals*

GENERAL CHEMICAL DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N. Y.

Offices: Albany* • Atlanta • Baltimore • Birmingham* • Boston* • Bridgeport* • Buffalo* Charlotte* • Chicago* • Cleveland* • Denver* • Detroit* • Houston* • Jacksonville Kalamazoo • Los Angeles* • Minneapolis • New York* • Philadelphia* • Pittsburgh* Portland (Ore.) • Providence* • St. Louis* • San Francisco* • Seattle • Yakima (Wash.)
In Wisconsin: General Chemical Company, Inc., Milwaukee, Wis.
In Canada: The Nichols Chemical Company, Limited • Montreal* • Toronto* • Vancouver*
SETTING THE PACE IN CHEMICAL PURITY SINCE 1882
*Complete stocks are carried here.

REAGENTS
B&A
STANDARD OF PURITY
FINE CHEMICALS

STEEL EYELETS NICKEL-PLATED TO A THICKNESS OF .00015"

The nickel solution in which these eyelets were plated was analyzed with a Patwin C-1 Electro-Polarizer. With this low-priced instrument, analysis of plating solutions can be made rapidly and accurately in your own shop —at a considerable saving in cost.

The Patwin Model C-1 is specially designed for polarographic analysis of plating solutions. It will determine principal constituents and metallic impurities in solutions of brass, cadmium, chrome, nickel and the precious metals. For detailed information, mail coupon below.

PATWIN INSTRUMENTS Division
THE PATENT BUTTON COMPANY, Waterbury, Conn.

Please send me information on the Patwin C-1 Electro-Polarizer.

NAME _____

FIRM _____

ADDRESS _____

CITY _____ STATE _____

Trade Literature

L—300. Chemical Porcelain—Bulletin CP-50 on "Chemical Porcelain" has just been released by the U. S. Stoneware Co., Akron 9, Ohio.

This 8-page bulletin fully illustrates and describes a complete line of chemical porcelain; pipe, fittings, spacers, vertical check valves, stop check valves, handwheel valves, plug valves, swivel joints, expansion joints, sight glasses, flanges, ejectors, and tower packing. For your copy of this informative bulletin, use Reader Service Card.

L—301. How To Grind and Polish Magnesium Alloys—A new 8-page technical bulletin issued by the Norton Co., Worcester, Mass., discusses the grinding of magnesium and its alloys.

Grinding wheel recommendations, typical procedures for polishing magnesium alloys, data on equipment requirements and sections on dust collection and safety precautions are detailed. The bulletin contains 3 figures and 1 table. For your copy of this material, use Reader Service Card.

L—302. Metablast Process Illustrated in New Booklet—The complete story on the newly developed Metablast process for controlled surface finishing is available in a new, 4-page, 2-color bulletin issued by the American Metaseal Manufacturing Corporation, West New York, N. J.

Photographs show how a predetermined, consistent finish can be applied to metal parts through the use of a special abrasive suspension applied to parts by means of air pressure. "Before and after" views of various parts are shown, and a detailed description of the operation of the new precision-built, space-saving Metablast machine is included. For your copy, use Reader Service Card.

L—303. Alloys and Fluxes for Welding, Brazing, Soldering, Cutting, Tinning—Just published by All-State Welding Alloys Co., Inc., 251 Ferris Ave., White Plains, N. Y., is a handy, pocket-size, buyers' guide to their complete line of alloys and fluxes for welding, brazing, soldering, cutting, and tinning practically all of the commercially used metals.

Though the new guide covers many more products than have been offered previously, it has been edited to condense complete buying information into 24 pages. The data have been better arranged and set in larger type. Included are 14 alloys and necessary fluxes for

THE *Chemical* CORPORATION

where New England turns for reliable service on

SPARKLER HORIZONTAL PLATE FILTERS

- Pennsalt Alkaline, Acid and Emulsion Cleaners
- Chandeysson Generators
- Pennsalt Fosbond and Fos process
- General Electric Rectifiers
- Heil Heat Exchangers and Chemical Resistant Tanks
- Inet Selenium Rectifiers
- Daniels Plating Barrels
- Meaker Plating Machines
- Stutz Plating Barrels
- Columbia Ammeters and Rheostats
- Republic Lead Anodes

and sound engineering advice.

THE CHEMICAL CORPORATION

Makers of

Luster-on,® Pla-Tank® and Stripode

Write for our new Metal Finishing Catalog

54 WALTHAM AVE., SPRINGFIELD 9, MASS.

MURRAY-WAY the automatic way the economical way the better way

to POLISH . . . BUFF . . . GRIND . . . FILTER

Whatever your job . . . whatever your problem . . . Murray-Way automatic equipment will do that job better and more economically.

These are just a few illustrations of Murray-Way's success in beating production cost with the finest automatic equipment available.

You can depend on Murray-Way engineering, Murray-Way experience, Murray-Way equipment to solve your production problems.

A. Micro-Polish—Continuous Strip Polishing Installation
B. Vertical-Platen Conveyor
C. Horizontal-Platen Conveyor
D. #51 Universal Polishing Head —One of Several Standard Polishing Heads
E. The Automatic, Self-Cleaning, Compact Filter
F. #72 Series Belt Polishing Head
G. Indexing Dial Table
H. Six Micro-Polish Units in Series

P. O. Box 180, Maple Road, E.
Birmingham, Michigan

MURRAY WAY CORPORATION

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 328

Trade Literature

work on aluminum and aluminum alloys; 8 for work on cast iron; 11 for work on copper and copper bearing alloys; 1 for work on magnesium; 4 for work on nickel; 8 for work on stainless steel; 11 for work on steel; 2 for work on zinc-base die castings; 1 for tinning, 1 for galvanizing, and 1 for cutting without oxygen. For your copy, use Reader Service Card.

L—304. Demineralizer Brochure—A new brochure, describing the latest model Penfield permanent cartridge demineralizer with laboratory stand has been printed by the Penfield Mfg. Co., 19P High School Ave., Meriden, Conn.

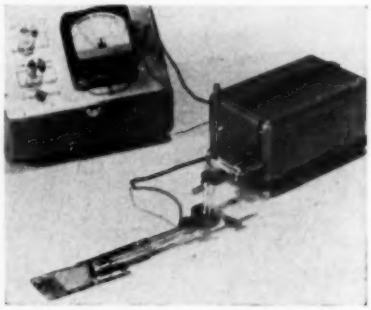
It illustrates this extremely efficient laboratory demineralizer in use (flow rate: up to 10 gallons per hour) and also shows an operation diagram.

The unit makes super high purity water "as handy as your tap." All that is necessary to set it in operation is to connect influent hose to tap and turn on water to proper flow rate as visually indicated by the exclusive Penfield flow meter. For your copy, use Reader Service Card.

L—305. Self-Sticking Marker and Label Bulletin—A new colorful bulletin containing practical, cost-cutting solutions to many special industrial marking problems has been published by W. H. Brady Company, Milwaukee, Wisc.

Actual size illustrations of pressure-sensitive markers and labels, tailormade by Brady for special applications, are shown in three colors. Included are trade marks, instruction, inspection, part numbers, Underwriters' and serially numbered labels. A sample dispenser card containing a variety of special labels made to customers' specifications is sent free with each copy of the new bulletin. For your copy, use Reader Service Card.

L—306. Surfindicator Accessory Bulletin—Brush Electronics Company, 3405 Perkins Ave., Cleveland 14P, Ohio, announces the availability of a new mechanical tracing accessory for use with the Surfindicator, an instrument which measures surface roughness.



The Brush Motor Drive, Model BL-114 provides mechanical movement of the Surfindicator pickup along a surface being inspected. It is designed for special applications which extend the usefulness of the basic Surfindicator beyond the range that is practical with hand operation.

The Motor Drive is especially recommended where the following considerations are of primary importance: highest possible accuracy, large quantity inspection of similar parts, very fine finishes, and very small areas. A catalog sheet gives further details on the unit. For your copy, use Reader Service Card.

L—307. Tumbling Barrel Catalog—A 12-page illustrated catalog showing the company's complete line of horizontal and tilting-type Globe tumbling barrels has been released by Hupp Corporation, 1250 W. 76th St., Cleveland 2P, Ohio.

Special features, such as the use of agitator strips and "work shifting" bottoms on the tilting barrels are illustrated with drawings and photos. Also covered is the company's newly designed flask-type tilting barrel, said to provide increased agitation with better control.

Charts are used to show capacities, speeds, etc., of each tumbling barrel, including direct-gear and belt-drive machines. Types of tumbling media and their job applications are listed. For your copy of this literature, use Reader Service Card.

L—308. Spray Nozzle Catalog—Spraying Systems Co., 3201 Randolph St., Bellwood, Ill., has just announced "the most comprehensive industrial spray nozzle

BRASS PLATING WITH TRUE BRITE

❶ improve color

❷ save labor

❸ eliminate supervision

❶ *color stays constant . . . no rejects*

❷ *eliminates frequent analyses . . .*

❸ *trouble free . . . only one addition instead of three*

Write for FREE bulletin! Your key to better Brass Plating

Available in regular 3 to 1 ratio for yellow Brass Plating.

Special ratio materials for plating richlow brass or any other desired alloy of copper and zinc.

Suitable for both still tanks and barrels.

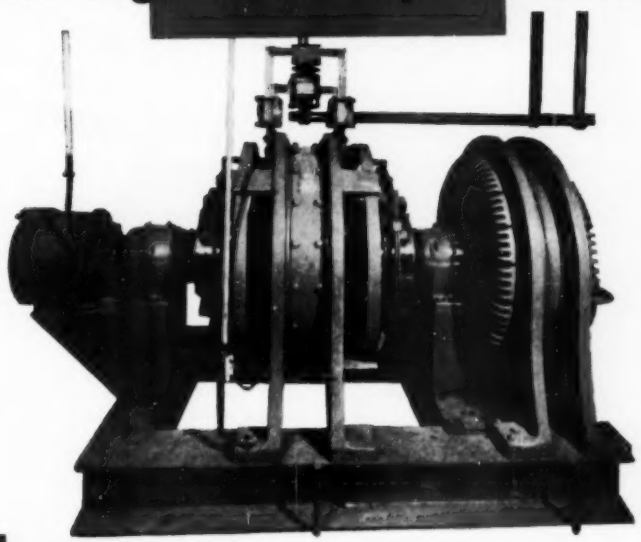
TRUE BRITE CHEMICAL PRODUCTS CO.

P. O. Box 31, Oakville, Conn.

CUT POWER COSTS PERMANENTLY...

Chandeysson MOTOR GENERATORS

for high-efficiency anodizing & plating



GOLDEN 1904 Chandeysson 1954 JUBILEE

Showing Chandeysson Generator that has served Miller Electroplating, Inc., for many years.

4 WAYS BETTER...

1. You'll use *less* power
2. Get more out of the power you pay for
3. Get extra overload capacity for long periods
4. Profit indefinitely — from peak performance built to last for years

Lifetime savings and satisfaction...

"CHANDEYSSON CUTS POWER CONVERSION COSTS"

...says Miller Electroplating, Inc. of Evansville, Indiana

"... We have three of your machines in operation in our plant. The last two being purchased after using the first one for over 20 years.

"Our first machine has been in use on the average of 16 hours a day. A great deal of this time, carrying an overload of from 20 to 25% of its rated capacity. During this time the only maintenance expense has been new brushes. It might be of interest for you to know that the commutator has not even been repaired during this time.

"We are indeed thoroughly sold on Chandeysson Plating Generators.

Very truly yours,
MILLER ELECTROPLATING, INC.

Paul E. Miller, Pres."

Cost-cutting performance is permanent in Chandeysson Motor Generators... built-in for the life of the unit. That life can be almost indefinite, as witness the Miller experience described here, and that of others whose Chandeysson installations are still in constant use after 48 years of service!

You get *immediate* savings, too. These units are capable of improving your overall plant power factor with resultant reduction of shop current for the same KW load all along the line!

Chandeysson Motor Generators are lastingly dependable, capable of carrying overloads for long periods — yet, they cost less than other methods of power conversion. We invite you to investigate. The coupon — or your letterhead — will bring you complete information.

CHANDEYSSON ELECTRIC COMPANY
4078 Bingham Avenue, St. Louis 16, Missouri

CHANDEYSSON ELECTRIC COMPANY
4078 Bingham Avenue, St. Louis 16, Missouri

Please send me a copy of Bulletin D-102.

Name .....

Company .....

Address .....

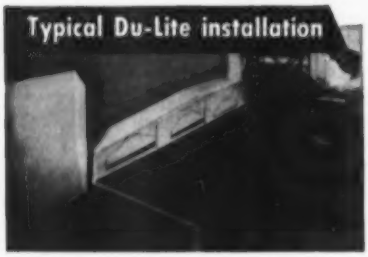
City ..... Zone ..... State .....

On any steel blackening problem

DEPEND on DU-LITE for a Superior Finish

Courtesy The Poly Choke Co.

Du-Lite gave this part with its complicated knurls, slots, threads, etc. a fine rust-resistant durable black finish. It is typical of many other parts, small and large, which have been black oxidized by Du-Lite for many years. Moreover, Du-Lite meets most individual and government specifications including 57-0-2C for Type III Black Oxide finish.



Du-Lite installations are simple, compact, easy to operate. Du-Lite equipment can be tailored to fit production requirements on all types of jobs with a maximum of speed and economy. Du-Lite also makes a complete line of cleaners, strippers, wetting agents, passivating agents, rust preventatives, burnishing compounds etc. for any metal finishing application.

See your nearest Du-Lite Field Engineer or write for more information.

DU-LITE CHEMICAL CORP.
MIDDLETOWN, CONN.

Rush information on your metal finishing products.

Name .....
Company .....
Address .....
City ..... Zone ..... State .....

Du-Lite
METAL FINISHING SPECIALISTS

Trade Literature

catalog ever printed." This complete reference catalog contains 48 pages. Thousands of standard and special industrial spray nozzles are illustrated and described. For each nozzle, complete data are listed covering capacity and spray angle. Dimensional specifications for all standard nozzles are also given. For your copy of this catalog, use Reader Service Card.

L—309. Article Reprint—A reprint of a paper on the "Analysis of Gold and Gold Alloy Solutions" by Dr. E. A. Parker of Technic, Inc., is now available to readers of this journal.

It is one of a series in Technic's efforts to correlate and assemble the great body of data on gold and its properties. A copy may be obtained by writing to Technic, Inc., 39 Snow St., Providence 1P, R. I., or by using Reader Service Card.

L—310. Plating Cylinders Bulletin—The metal finishing industry is shown its first detailed close-up of the complete line of "H-T Sincolite" replacement plating cylinders claimed to "fit any plating barrel superstructure . . . new or old," in a colorful 4-page bulletin, now released by The Singleton Company, 5317 St. Clair Ave., Cleveland 3P, Ohio.

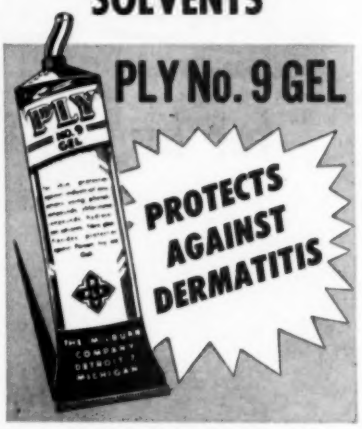
According to the literature, this is the only line of replacement cylinders suitable for the complete range of cleaning, pickling and plating cycles, and can save for plant owners their entire investment in old or obsolete superstructures, which would otherwise be a total loss.

Outlined are the several features exclusive with the various models offered, all of which are heavy-ribbed design and fusion-welded construction throughout and made of H-T Lucite or Plexiglas. For your copy of this bulletin, use Reader Service Card.

L—311. Permutit Precipitator—A well illustrated 20-page booklet, describing the many applications, principles of operation, design features, advantages, recommendations, flow diagrams, and specifications of the Permutit Precipitator in its three basic designs has been prepared and released by The Permutit Company, 330 W. 42nd St., New York 36P, N. Y.

According to the manufacturer, the precipitator offers an efficient means of removing impurities from a liquid by precipitation, adsorption, settling and filtration. The unit requires less space, less chemicals and less reaction time than previous designs. Chief uses are in water softening; the removal of turbidity, color, taste, odor, alkalinity, silica and fluorides. For your copy of the booklet, use Reader Service Card.

IF YOUR EXPOSURE IS HIGHLY IRRITATING SOLVENTS



It's a proven fact. Actual tests show Ply No. 9 Gel effective against chemicals causing dread Dermatitis.

This non-irritating gel, developed and thoroughly tested over a period of years under actual working hazards, is completely transparent, spreads easily and becomes invisible on the skin.

Ply No. 9 Gel contains the ingredient "Milbex" to prevent spotting or corroding of highly finished metals due to acid deposits from perspiration or any moisture caused by handling.

With Ply No. 9 Gel the worker no longer need fear the most commonly used acids, resins and solvents. Whatever the hazard, Milburn has developed a specific Ply Cream to combat it.

FREE! WRITE FOR THIS VALUABLE BOOK!

"The Answer to Industrial Dermatitis"

SPECIFY PLYGLOV FOR 10 TIMES THE WEAR

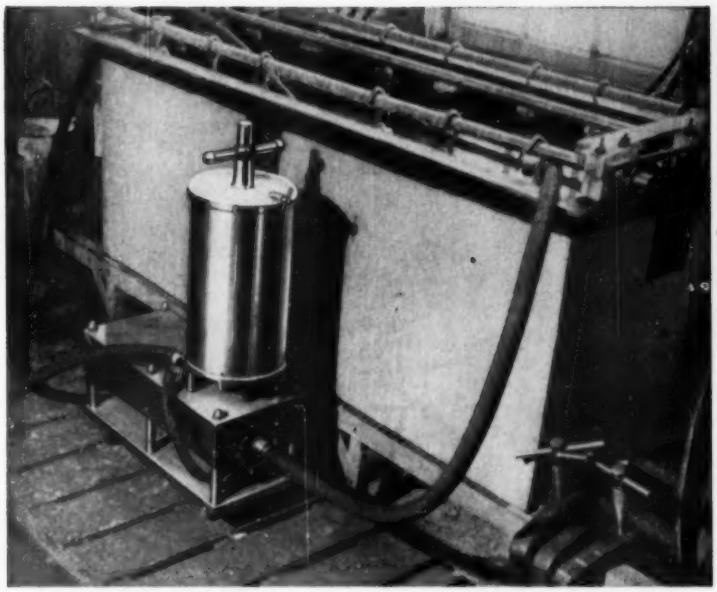
Plyglovs can reduce your work glove costs as much as 75% – will outwear up to 10 ordinary pairs. Plastic coated to protect hands from industrial liquids.

THE MILBURN CO.
DETROIT 7, MICH.
PLY

The Standard of Perfection in Protection

Here's how to cut your losses

get better finished plated work — save time and labor



The "Sealed-Disc" Filter will remove all dirt, dust, and sludge from your plating solutions. You'll no longer worry about pitting, spotting, poor adhesion, formation of nodules, etc.

More and more platers testify to the remarkable savings in operating time and labor that the "Sealed-Disc" Filter gives them. These cost-minded platers get better finished plated work and have found that their solutions last longer. "Sealed-Disc" Filters, designed to meet plating room requirements, are smaller, more compact and portable, than ordinary conventional filters.

Regardless of the size or type of your installation, there's a "Sealed-Disc" Filter to "fit your job." You can depend on a "Sealed-Disc" Filter for positive, trouble-free performance that's proof against even the invisible impurities that cause nodules and porousness, proof against losses caused by rejects and reworking. Write for complete details or contact your regular plating supplier.

ALSOP
ENGINEERING CORPORATION
903 Fine Street Milldale, Connecticut

Other Alsop Plating Room Equipment

We manufacture a full line of Mixers and Agitators covering a complete range of sizes, for mixing, blending, and dissolving. Stainless Steel Mixing Tanks are also available in a wide range of capacities. For full details and illustrations write for your free catalog.

"the bright finish starts the sale"

We are proud that the CARROLLTON Manufacturing Company uses Exolon abrasives to give its stainless steelware the eye-catching, sales-starting, high-lustre you see above. Exolon abrasive grains have proved their efficiency in every polishing situation.

These grains — made to unvarying high standards — have sharp cutting edges, are uniform in size and shape, and are specially treated to improve adhesion. Iron particles are removed. Such manufacturing uniformity insures *you* of faster, easier polishing, uniformly fine finishes with substantial savings of time, labor, and abrasive material.

Write today for full information on how EXOLON ABRASIVES will make your products look better and sell better, while reducing production costs.

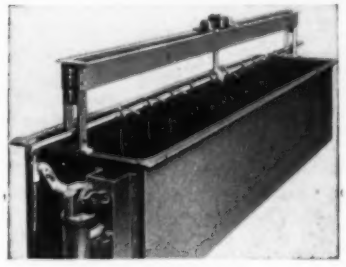
The EXOLON Company

973 EAST NIAGARA STREET TONAWANDA, NEW YORK

MANUFACTURERS OF SILICON CARBIDE AND ALUMINUM OXIDE ABRASIVES

Equipment and Supplies

E—312. New Cathode Rod Support for Plating Tank with Rod Agitator—Sagging cathode rods are eliminated without loss of plating space by a new cathode rod support developed by Belke Manufacturing Co., 947 N. Cicero Ave., Chicago 51P, Ill.



The new support, developed for use with rod agitators, is carried by structural steel members positioned over the cathode rod and mounted on the ends of the tank. The members are mounted high to afford plenty of room for hooking racks on the cathode rod and taking them off.

One end of the support is attached to the cathode rod in a fixed position; the other end is equipped with a grooved roller which runs on a short rod mounted on the structural members. For more information on this equipment, use Reader Service Card.

E—313. Redesigned Process Timer Line—A new line of process timers for providing accurate, adjustable time-delay opening and closing of electric contacts, has been announced by the General Electric Company's Meter and Instrument Department.

Designated G-E Type TSA-18, the timers can control such process equipment as hydraulic presses, baking equipment, heat-treating ovens, sirens, mixing machines, signals and conveyors. For more information on these timers, use Reader Service Card.

E—314. High-Speed Paint Stripper—Northwest Chemical Co., 9310 Roselawn, Detroit 4P, Mich., announces the development of Liquid Stripper No. 6—a completely new approach to the problem of chemical stripping of paint and other organic finishes from steel, magnesium, and zinc castings.

This new material, closest development to a "universal" paint stripper, has

Koppers Potassium Cyanide Solution

HANDLING potassium cyanide granules is dangerous, troublesome, and time-consuming. It necessitates dissolving, drum storage, drum cleaning, and disposal of potentially dangerous, half-cleaned drums. And it needlessly exposes working personnel to poisonous cyanide powder dust.

With Koppers Potassium Cyanide in solution form, these risks are minimized. The solution is delivered to you by tank truck, pumped directly from the truck into your storage tank, ready to use, or in 55-gallon drums from which the final traces of solution can easily be removed by a water wash. No preparation is necessary.

Koppers Potassium Cyanide, 35-40%, is widely employed in electroplating where copper is used as a base coat for chromium plating. It forms soluble complexes with copper, silver, gold, cadmium, zinc, and other metals of the general form $E_2M(CN)_3$ or $K_2M(CN)_4$. It possesses extremely low sulphur content and high purity.

Due to its time- and labor-saving convenience, Koppers Potassium Cyanide solution is *actually less expensive* than its solid counterpart.

Potassium Cyanide is one of the many synthetic chemicals produced by Koppers, including Resorcinol, Styrene Monomer, Polystyrene, Phthalic Anhydride, Divinylbenzene, and Di-tert-butyl-para-cresol.

KOPPERS COMPANY, INC.
Chemical Division, Dept. P-34, Pittsburgh 19, Pennsylvania

KOPPERS ® **Koppers Chemicals**

SALES OFFICES: NEW YORK • BOSTON • PHILADELPHIA • ATLANTA
CHICAGO • DETROIT • LOS ANGELES

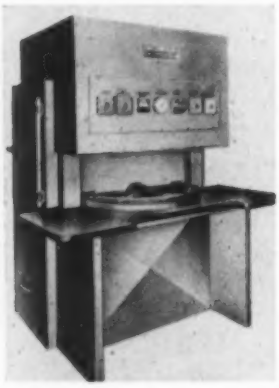
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 335.

proven its ability in completely removing organic finishes phenomenally fast, in one run-through, without harm to the metal surface.

It is safe, involves no fire hazard, has no odor, no fumes, and is nontoxic.

The stripper converts the paint film into a soluble form—easily rinsed off—and contains no chemicals which cannot be flushed through sewers. For more information on the product, use Reader Service Card.

E—315. Automatic Wet-Blaster—The addition of a new, versatile automatic model to its line of standard, manually operated units has been announced by the Cro-Plate Co., Inc., 747 Windsor St., Hartford, Conn.



Known as the Pressure Blast Roto-Matic, this new concept in wet-blasting equipment was designed for the elimination of hand filing, grinding, wire brushing and chemical cleaning of small metal parts and various plastic and ceramic components.

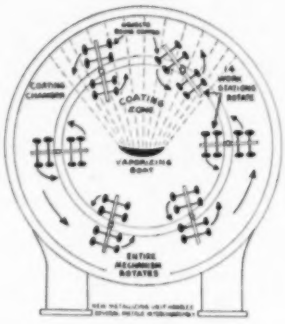
In operation, the operator is seated at the front of the unit and merely loads and unloads work-pieces from the rotating table which incorporates appropriate work holding fixtures. The cabinet interior is divided into three chambers accessible from all sides by means of inspection doors.

A simple, readily accessible panel contains all necessary controls for operation. The only requirement in switching from one type of work to another is a change in work holding fixtures and a repositioning of the blast guns. More guns may be added at any time. For more data on this equipment, use Reader Service Card.

E—316. Heavy-Duty Dynel Work Clothes—A new type of heavy-duty work clothing, made with Dynel, is announced by Chem-Wear, Inc., Darien, Conn.

The fabric in the new garments is a melton containing 25 per cent Dynel and 75 per cent reprocessed wool. Results of strength tests on the fabric show that it averages 10 to 15 per cent stronger than all-wool of the same weight, and the blended fabric has at least 40 per cent higher tear strength. Both factors prolong garment life appreciably. For more information on this product, use Reader Service Card.

E—317. New Metalizing Unit Is First To Handle Silver, Gold, Copper and Aluminum Coatings Interchangeably—The High Vacuum Equipment Corporation of Hingham, Mass., announces



the development of the first commercial high vacuum metalizing unit specifically designed to handle gold, silver, copper and aluminum coatings on a completely interchangeable production basis with equal efficiency.

The new unit features a readily removable interior mechanism. The metal to be evaporated is held in resistance-heated "boats" on stationary rods running through the axis of the cylindrical chamber. Silver, gold, copper or aluminum which is evaporated from the "boats" disperses in an upward direction through an arc of 60° to 90°. The pieces to be coated are attached to the six "riser rods" or work stations. As this entire mechanism is rotated, each of the six work stations are successively passed through the arc of evaporating metal and the work is coated. For more information on this equipment, use Reader Service Card.

E—318. Adjustable Fog Gun—A new fog gun developed by Bete Fog Nozzle Inc. of Greenfield, Mass., is adjustable to deliver a pattern from a soft conical fog to a hard driving jet. Adjustment is made instantly by turning a rubber gripped handle one-half turn. Wide or narrow angle fog cones with any desired coverage or drive can be obtained, according to the manufacturer. Instant on-off control is obtained by means of the trigger shut-off included with the nozzle. For more information on this product, use Reader Service Card.

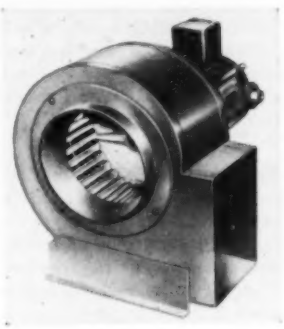
E—319. Chelating Agent for Trivalent Iron—"Versen-OL" is the name of the new product which should have wide application in wet processing wherever trace iron creates a problem and causes trouble through its contaminating influence. Known chemically as the trisodium salt of N-hydroxyethylethylenediamine triacetic acid, the new compound is extremely soluble in water and highly stable throughout the *p*H range.

Versen-OL, discovered and developed by the Bersworth Chemical Company, Framingham, Mass., is the newest of the "Versenes." For more data on this new product, use Reader Service Card.

E—320. Improved Line of Tote Boxes—With the expanded facilities recently installed in their plant at 98 South St., New Britain, Conn., now in operation, the Industrial Bench & Equipment Manufacturing Co. has redeveloped the line of tote boxes purchased from the New Britain Machine Co.

The stacking type tote box is among the most popular styles to be improved. Now, all welds are guaranteed indefinitely. The box is made stronger, of a heavier gauge steel, sturdy, durable and compact. The handles are of pressed steel, folded double to afford a comfortable hand-hold. Holes are punched to permit the use of hooks. Drop handles also can be furnished. For more information on this product, use Reader Service Card.

E—321. Economical High-Volume Blower—A large capacity blower for quick removal of fumes, smoke, and stale air, or for cooling and ventilating, is now



being offered by Standard Electric Mfg. Co., Inc., West Berlin 12, N. J. Moving up to 600 cubic feet of air per minute, the blower features an automatic cutout which stops the completely enclosed 110-volt 60 cycle motor before it can overheat.

Smaller sizes with different capacities and current characteristics are available also. For additional information, use Reader Service Card.

E—322. Small Parts-Filing Cabinet—General Industrial Co., 5738 N. Elston Ave., Chicago 30P, Ill., announces production of a complete line of "see-thru" drawer cabinets for small-parts filing and storage.

Belke

New LUCITE PORTO-PLATER

only $167.50

with 9x15" O.D. Cylinder
115 V, 60 C, 1 Ph. Motor

also
14x30 and 14x36 Plating Barrels and full Barrel Cycle Lines at very reasonable prices!

Ask your BELKE Service Engineer or write.

Features of Model SPX Porto-Plater

Notched "V" Cathode Contact fits Cathode Rod at any point on the rod.

Complete Lucite End Plates — Support plater — protect cylinder and mechanism in handling.

Reversing Switch with self-contained motor drive —Motor turns cylinder in either direction and holds positively for loading and unloading.

Obstruction-free Cylinder—One-piece molded High Temperature Lucite shell welded to cylinder ends. No ribs, no tie rods, no crevices.

Attached Lucite Cover Locks — Always on the cover. Never misplaced or dropped in tank.

Ball Contact with one-piece dangler cable.

High Temperature Lucite—Cylinder, cover, cover locks, hangers, gears and bushings.

Cylinder perforations 3/32" unless specified.

Cylinder, O.D. 9x15"; I.D. 6x12".

Weight Empty, 28 lbs. Plating Capacity, ¼ peck.

Geared head motor, 1/50 HP, 115 V, 60 C, 1 Ph.

BIGGEST VALUE ever produced in a LUCITE PORTO-PLATER

New features and low price, made possible by BELKE BIG VOLUME PRODUCTION, add up to TREMENDOUS VALUE far greater than ever before obtainable.

A flood of orders in excess of production has created a big backlog with extended delivery dates.

To avoid disappointment, please order well in advance of your needs. Deliveries must be scheduled on the basis of first come first served.

Belke Manufacturing Company
947 N. Cicero Ave., Chicago 51

EVERYTHING FOR PLATING PLANTS

Equipment and Supplies

The popular model J-20 consists of twenty crystal-clear lifetime-guaranteed plastic spillproof drawers, 5⅞ x 2¾ and 1⁷/₁₆ inches high, in a welded all-steel cabinet. Overall size is 10¼ x 12½ x 6 inches. The cabinet has an attractive silver-gray hammer finish and is equipped with rubber feet. Adjustable drawer dividers and identification labels are included. For more information on this product, use Reader Service Card.

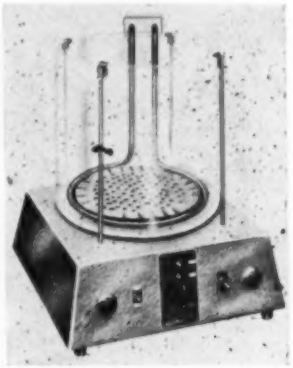
E—323. Brass Plating Addition Agent—Jelco Products, 153 E. 26th St., New York 10P, N. Y., announces a new line of plating addition agents.

The first of these materials is "Brass Additive" for which the following claims are made: Will assist in maintaining an even brass color. Will eliminate cyanide and ammonia fumes while solution operates. Increases both efficiency and throwing power. Gives brighter deposit faster. Can be added to any standard brass plating solution. Aids in anode depolarization. Allows higher current density to be used. For more information of this material, use Reader Service Card.

E—324. Agilene Bottle Carriers—Handling and carrying of large size bottles containing concentrated acids has always been an occupational hazard for laboratory and chemical plant workers, and many accidents have resulted from careless treatment of these fragile containers.

Now, however, danger of such accidents can be practically eliminated by use of an Agilene bottle carrier, manufactured by American Agile Corporation, P. O. Box 168, Bedford, Ohio. This carrier is made entirely of corrosion resistant polyethylene, and is light in weight and unbreakable. A bail type handle is provided and the snug fitting cover holds the bottle safely in position, even when tilted for pouring. For more information, use Reader Service Card.

E—325. Magni-Whirl Jar Bath—The new full visibility Magni-Whirl jar bath features 99.9 per cent working space always usable and with 100 per cent visibility. It obsoletes the need for any motors, stirrers or circulating systems of



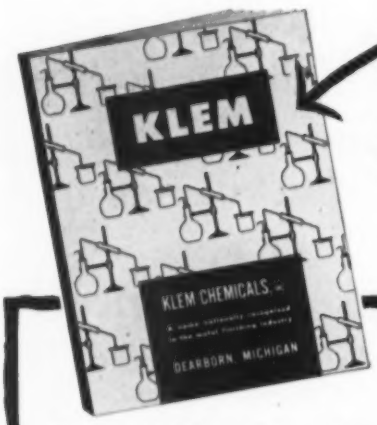
any type, yet provides complete uniformity and automatic, gentle, efficient agitation in all areas of bath irrespective of work load.

Complete uniformity and agitation is maintained by means of gentle pulsation of a perforated agitator plate. The plate is pulsated by a powerful electromagnet, located in the base support. For more data on this equipment, use Reader Service Card.

E—326. Corrosion Resistant Joint—Atlas Mineral Products Co., Mertztown, Pa., announces the development of a solvent, acid, alkali, and salt resistant joint suitable for waste lines in chemical process plants. This combination joint will withstand hot corrosive effluents which will attack almost all previously known jointing materials. For more details, use Reader Service Card.

E—327. New Cold Galvanizing Process—After three years of extensive testing, an entirely new method of cold galvanizing for surface protection of steel and iron has been announced by the Galvicon Corp., 40 W. 29th St., New York 1P, N. Y.

Galvicon, the new coating, manufactured solely in the United States, and now available for general distribution, may be applied with an ordinary paint



Write for this catalog — describes 31 standard surface preparation chemicals, electrolytic and emulsion cleaners, one stage strippers, etc.

Your difficult surface cleaning problem may be a "pushover" for the experts

Klem Field Engineers are specialists in the cleaning and preparation of parts surfaces, qualified to solve most problems on the spot—backed by lab facilities that duplicate your plant conditions and where a quick answer may be had on the particularly tough jobs.

You'll like working with Klem. They'll get results for you and make your work easier.

There's a KLEM engineer near you

KLEM CHEMICALS, Inc.

14401 LANSON AVE., DEARBORN, MICHIGAN

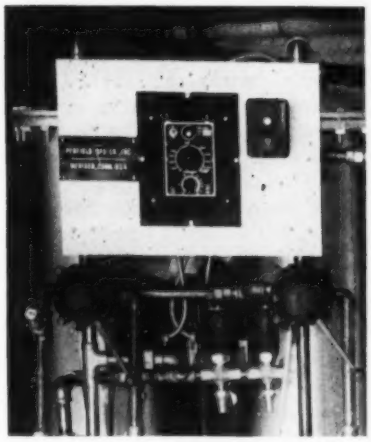
brush, electric spray gun or by cold dipping. Special equipment or personnel training is not necessary.

The new process gives effective results on any structure from an iron or steel bridge to a rusted garden gate.

Galvicon offers true cathodic protection. It leaves a coating in excess of 96 parts by weight, of zinc. For more information on this material, use Reader Service Card.

E—328. Automatic Demineralizer Cuts Labor Costs to a Minimum—A demineralizer equipped with special controls which enable the automatic maintenance of storage tank water supplies at a definite known purity standard has been announced by Penfield Mfg. Co., 19 High School Ave., Meriden, Conn.

After the regeneration cycle has been completed and is in its final rinse stage, the operator switches on the unit's automatic controls which then perform all required functions completely automatically, including signaling when another regeneration cycle is needed.



Once these automatic controls take over, the effluent continues to run to drain until a desired preset conductivity (purity) has been reached. At this time, the super high purity water being produced starts to flow to the storage tank and continues to so flow until the storage tank is filled.

When storage tank level falls to a predetermined level, the Penfield demineralizer automatically starts another delivery cycle, allowing only water of the preset purity standard to reach the storage tank and automatically turning off when the storage tank has been refilled.

Should the purity drop while the storage tank is being filled, the unit automatically runs to drain und in the event proper conductivity does not come back within 27 minutes the unit will automatically stop and signal lights. For more data on this equipment, use Reader Service Card.

E—329. Air Dryer—A new adsorption air dryer, capable of maintaining "desert dry" atmosphere in controlled small premises, has been announced by Bryant Heater Division, Affiliated Gas Equipment, Inc., 17820 St. Clair Ave., Cleveland 10P, Ohio.

First adsorption air dryer in production, the Bryant unit will reduce relative humidity in controlled areas from as high as 90 per cent to 8 per cent.

The air dryer is plugged directly into 115 volt electric circuits. It may be controlled by a standard humidistat, and requires no drains or other connections.

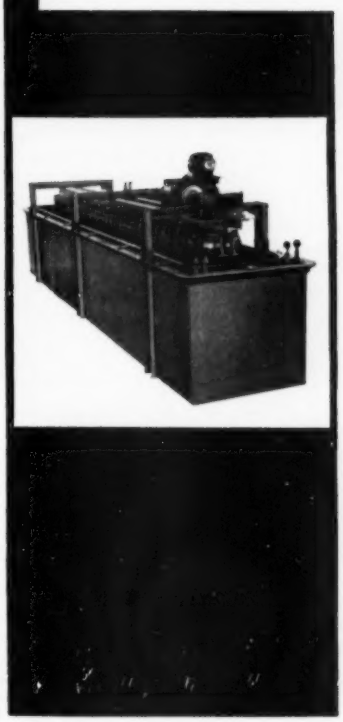
In periods of high humidity, the unit will remove from the air up to 21 pints of water per day. The air dryer mechanism will not frost, and its efficiency improves as its control level is lowered. For more information on the unit, use Reader Service Card.

E—330. Fiberglas Laminate for Concentrator Stack—A concentrator stack made of a special Iolyte laminate of Fiberglas and cotton has been made for a Southern chemical plant. This stack is 32 ft high and has a diameter of 5 ft. It was fabricated to specifications in three sections and shipped by flatcar. The joints for assembly of the sections were made at the site. This stack was constructed for hydrofluoric acid fumes.

Schori Process Division of Ferro-Co. Corp., 8-11 43rd Rd., Long Island City 1, N. Y., is the manufacturer. This company uses Iolyte (trade name for their Fiberglas reinforced polyester laminate) in the manufacture of concentrator stacks, chemical exhaust systems, filtrate troughs, and chemical production equipment such as tanks, crocks, ducts and hoods. For further information on this material, use Reader Service Card.

permanent protection . . .

greater safety



MANHATTAN
RUBBER LININGS

For complete protection against tank corrosion and solution contamination, manufacturers of plating and pickling equipment specify Manhattan Rubber Linings.

Manhattan Rubber Linings are the result of over fifty years development by Manhattan engineers to produce the most economical and dependable rubber linings in the industry today. Every Manhattan Lining is made from calendered sheets of natural or synthetic rubber in required thickness to eliminate plating "risks" and stray currents . . . and to give more protection and longer, better service. Every Manhattan Lined Tank is dielectrically tested to 15,000 volts to detect any imperfections. Manhattan's exclusive rubber-to-metal bond insures permanent protection under severest operating conditions.

For economical, dependable linings which meet your most exacting requirements, specify Manhattan Rubber Linings. You get "More Use per Dollar" with Manhattan Rubber Linings in two ways . . . they provide more protection and they last longer . . . proved by records of uninterrupted service of 25 years and more.

RM 443

RUBBER LINING PLANTS AT PASSAIC, N. J. AND NORTH CHARLESTON, S. C.

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose
Fan Belts • Brake Linings & Blocks • Clutch Facings • Packings • Asbestos Textiles
Engineered Plastic, and Sintered Metal Products • Abrasive & Diamond Wheels • Bowling Balls

Available for Immediate Shipment, Attractive Values

THE FOLLOWING EXCELLENT REBUILT AND GUARANTEED ELECTROPLATING MOTOR GENERATOR SETS AND RECTIFIERS, WITH FULL CONTROL EQUIPMENT:

PLATERS

1—7500/3750 AMPERE, 9/18 VOLT, **HANSON-VAN WINKLE-MUNNING**, Synchronous.
1—5000/2500 AMPERE, 8/16 VOLT, **ELECTRIC PRODUCTS**, 25° C., Synchronous, Exciter-in-head.
1—5000/2500 AMPERE, 9/18 VOLT, **COLUMBIA**.
1—5000/2500 AMPERE, 8/16 VOLT, **CHANDEYSSON**, 25° C., Exciter-in-head.
1—5000/2500 AMPERE, 6/12 VOLT, **CHANDEYSSON**, 25° C., Synchronous, Exciter-in-head.
1—4000/2000 AMPERE, 6/12 VOLT, **CHANDEYSSON**, 25° C., Exciter-in-head.
1—3000/1500 AMPERE, 6/12 VOLT, **COLUMBIA**, Synchronous.
1—2500/1250 AMPERE, 9/18 VOLT, **ELECTRIC PRODUCTS**, Synchronous, Exciter-in-head.
1—2000/1000 AMPERE, 8/16 VOLT, **ELECTRIC PRODUCTS**.
1—1500/750 AMPERE, 6/12 VOLT, **HANSON-VAN WINKLE-MUNNING**, Synchronous, Exciter-in-head.
1—1500/750 AMPERE, 12/24 VOLT, **CHANDEYSSON**, Synchronous, Exciter-in-head.
1—1000/500 AMPERE, 6/12 VOLT, **ELECTRIC PRODUCTS**.

ANODIZERS

1—4000 AMPERE, 40 VOLT, **CHANDEYSSON**, Exciter-in-head.
1—1000 AMPERE, 30 VOLT, **IDEAL**, Exciter-in-head.
1—1000 AMPERE, 40 VOLT, **CHANDEYSSON**, 25° C.
1—750 AMPERE, 60 VOLT, **HANSON-VAN WINKLE-MUNNING**, Synchronous, Exciter-in-head.
1—500 AMPERE, 25 VOLT, **CHANDEYSSON**, Synchronous, Exciter-in-head.
1—400 AMPERE, 40 VOLT, **M. G. C.**, Exciter-in-head.

RECTIFIERS

BRAND NEW BASIC RECTIFIERS, 1500/750 amperes, 6/12 volts. Special Price: $750.00 each. Separate Voltage Controls available.
1—2000 AMPERE, 6 VOLT, **G. E.** COPPER OXIDE, and Control.
1—**GREEN SELECTOPLATER**, 1800 AMPERE, 12 VOLT, 220/3/60.
1—**UBYLITE-MALLORY**, 1500/750 AMPERE, 6/12 VOLT, Control.

SPECIAL

1—No. 200 **RONCI** LACQUER MACHINE.
1—**UNICHROME** CHROME BARREL PLATER, Model No. 24B, Series No. 31.
1—**CROWN** 18 x 18 CENTRIFUGAL DRYER, Steam Heat.
3—No. 1 and No. 2 **HARTFORD** TRIPLE-ACTION BURNISHING BARRELS, Lined and Unlined, Belted.

Above is partial list only. Write to us for all your requirements for Plating, Anodizing and Metal Finishing

WIRE—PHONE—WRITE

M. E. BAKER CO.

25 WHEELER STREET

Kirkland 7-5460 CAMBRIDGE 38, MASS.

Mail Box

Subject: Cleaning of Copper Alloy Wave Guides Prior to Plating

GENTLEMEN:

On page 1231 of the November issue of PLATING, Mr. Trembley of Texas Instruments, Dallas, Texas, discussed a problem that he and many other manufacturers have of cleaning intricate shapes made of copper and brass that have been silver soldered. In the soldering operation, oxides of copper form, notably cuprous which is extremely difficult to remove. The cleaning procedures outlined involve the use of chromic acid mixtures with or without nitric acid. Such mixtures do not dissolve the cuprous oxide directly but tend to remove it by undermining. As a result, there is a great deal of preferential attack and, as mentioned in the discussion, the attack may be so severe that the pieces are rendered useless.

We have been presented with the problem of pickling surfaces of this type as well as thin gauge sections that would be completely dissolved by the use of chromic acid mixtures. We have found a solution to the problem that may be applicable to the cleaning of wave guides. The basis of the solution is to convert the cuprous oxide to cupric oxide by means of an alkaline oxidizing mixture, such as mixtures of sodium hydroxide and sodium chlorite (designated as Ebonol "C" under U. S. Patent Nos. 2,364,993, 2,460,896, 2,460,898, and 2,481,854). This mixture converts the copper surface as well as the cuprous oxide to cupric oxide, which can be readily dissolved by means of either sodium cyanide solutions or dilute acid, such as 5 per cent sulfuric. Inasmuch as the entire surface is converted to cupric oxide, there is very little differential attack, although there will be some removal of metal. Unlike, however, the case with chromic acid treatment, no pitting or perforation will occur. The cycle of oxidizing followed by removal of the oxide in acid frequently has to be repeated several times if the cuprous oxide coating is thick.

WALTER R. MEYER

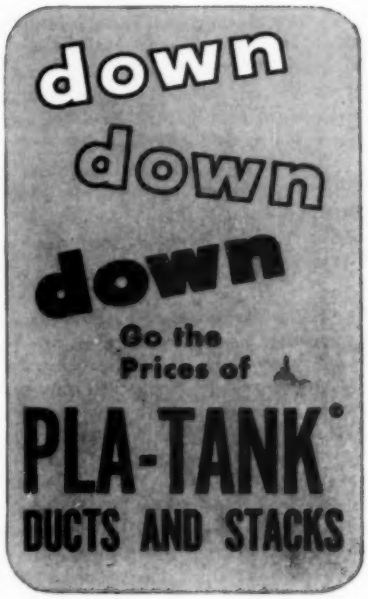
Subject: Editorial Tribute to G. B. Hogaboom

DEAR SIRS:

Our family is deeply appreciative of the idea that the men behind PLATING are doing for Papa. There isn't anything you could have done to make him happier. The whole thing has made me dissolve in tears. Bless your hearts.

Most sincerely,

GLADYS HOGABOOM CROCKETT
Mrs. (Charles N.)



Yes, we've just made drastic cuts in the prices of our famous duct and stack systems. Our research and product development program is beginning to *really* pay off. We can now make better-than-ever Pla-Tank ducts and stacks at less cost to *us.* So, we're passing the savings along to *you.*

These new, low prices are the result of considerable experience building large systems and improved manufacturing methods. The use of a new lay-up system gives a lighter product for easier handling and neater installation with the *tremendous* advantage of extra added strength.

Now, you can get improved PLA-TANK ducts and stacks (in standard round shapes *only*) at unbelievably low prices. Pla-Tank ducts and stacks are now without question your best buy — and highly competitive with *all* types of chemical resistant plastic material.

Write for free Data Sheets and NEW LOW Price Lists Today!

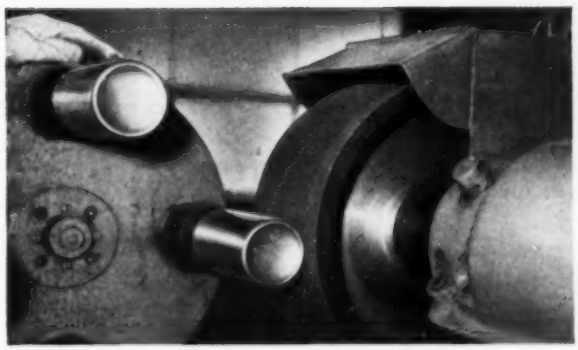
P-16

THE *Chemical* CORPORATION

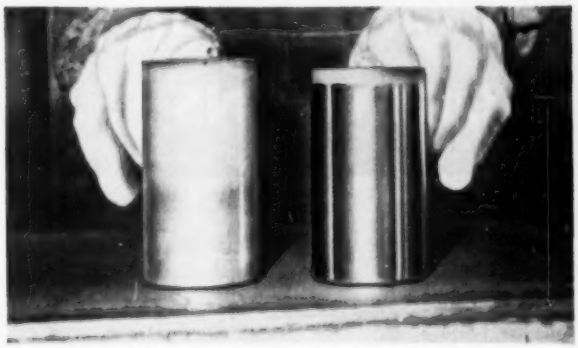
87 Waltham Ave., Springfield 9, Mass.

How would you solve it?

(1) Production Problem: To cut unit costs of grinding and polishing stainless steel whip-cream dispenser cans. Nilsen Mfg. Co. had been jobbing out the cans to an outside source, paying a high .08¢ per can, due to old-fashioned methods, labor, material and delivery costs.



(2) Solution: A 3M Representative recommended that this Addison, Illinois, manufacturer install the 3M Method, using Grit #180 Resin Bond Belts running over a special contact wheel. Cans were placed on automatic work holders.



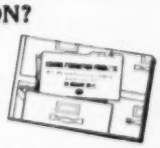
(3) Results: An immediate reduction in polishing costs. By installing the 3M Method, and doing the work themselves, Nilsen Mfg. Co. cut costs to only $.0125 per finished unit . . . a saving of $.0675 per can! A 3M Representative can help you solve your grinding and finishing problems, too. His services are available without cost or obligation.

3M ABRASIVES

Made in U.S.A. by Minnesota Mining and Mfg. Co. General Offices: St. Paul 6, Minn. In Canada: London, Ont., Can. Export: 122 E. 42nd St., New York City. Makers of "Scotch" Pressure-Sensitive Tapes, "Scotch" Sound Recording Tape, "3M" Adhesives, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing.

WANT MORE INFORMATION?

Minnesota Mining & Mfg. Co.
Dept. P-34 St. Paul 6, Minn.



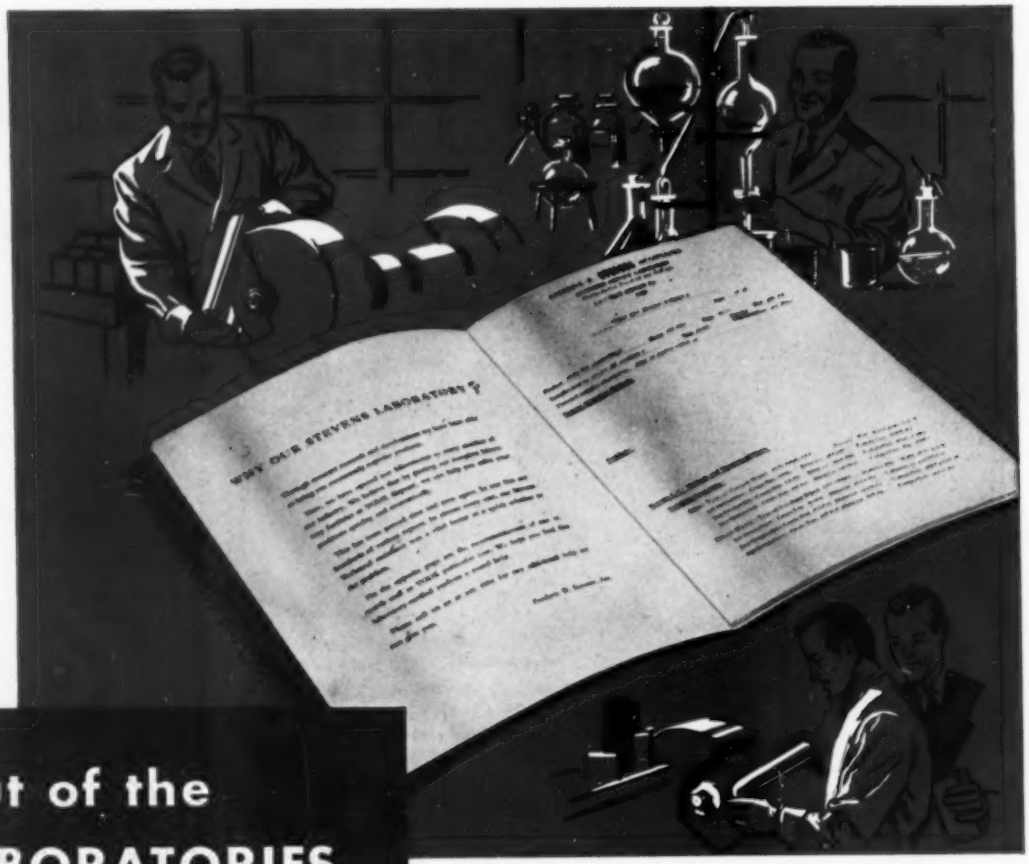
☐ *Send me free booklet: "Case History Reports on 3M Abrasive Belts"*
☐ *Have 3M Representative Call*

NAME_____ **TITLE**_____

COMPANY_____

ADDRESS_____

CITY_____ **ZONE** ____ **STATE**_____



Out of the LABORATORIES OF STEVENS . . .

an LV* *report to perfect your product finish*

You can unveil new ways to cut costs and improve your polishing and buffing methods by using the *obligation-free* facilities of the Stevens Customer Service Laboratories. Our Technical Research staff will thoroughly survey your product and prepare a Stevens LV* Report for you. The report will point out the most effective combination of buffs, compositions and equipment to obtain the finish you desire.

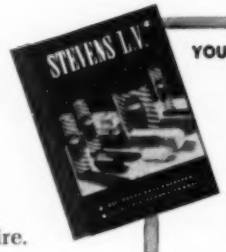
Often, the finest of hand-finishing results are obtained at greatly reduced cost, on automatic equipment. When this is possible, such recommendations will also be included in a Stevens LV* Report.

Call a Stevens Sales Engineer or write Stevens direct to arrange a laboratory test of your polishing and buffing operation. FREDERIC B. STEVENS, INC., Detroit 16, Michigan.

**Laboratory-Verified*

BRANCHES: **BUFFALO • CLEVELAND • INDIANAPOLIS NEW HAVEN • DAYTON**

IN CANADA: **FREDERIC B. STEVENS OF CANADA, LTD., TORONTO • WINDSOR**



YOU CAN PROFIT FROM THIS FREE BOOKLET!

The Stevens LV* Booklet was compiled from hundreds of Stevens LV* Reports. It describes up-to-date, laboratory-proved methods for polishing and buffing all types of material and contains many reference tables and other valuable metal finishing information. For your copy, simply send a letter or postcard requesting the Stevens LV* Report Booklet (No. 51), with your name, company and address.

STEVENS

YOUR METAL FINISHING SUPERMARKET

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 342.

plating

Dedicated to the improvement and dissemination of the knowledge of the arts and sciences of electroplating and of finishing of metals and of allied arts.

MARCH, 1954 VOL. 41, No. 3

Contents

The Polarographic Analysis of Nickel Plating Solutions..... 262
J. V. Petrocelli and G. Tatoian

The Use of Unplasticized Polyvinyl Chloride in Electroplating Plants..... 269
L. N. Thomas

Industrial Waste Control..... 275
D. Gardner Foulke

41st Annual Convention..... 278

A.E.S. RESEARCH REPORT:

Project No. 12: Cleaning and Preparation of Metals for Electroplating. VIII. Effect of Oxide Films—A Survey of the Literature..... 279
Henry B. Linford and David O. Feder

Monthly Features

Advertising Index..... 330
AES Directory..... 329
AES News..... 310
Article Abstracts..... 292
Book Review..... 288
Branch News..... 312
Editorial..... 261
Equipment and Supplies..... 251
Future Meetings..... 332
Industry News..... 222
In This Issue..... 220
Mail Box..... 256
Membership Report..... 327
Patent Abstracts..... 298
Personals..... 236
Question Box..... 290
Tricks of the Trade..... 291
Trade Literature..... 244

Staff

Managing Editor
P. PETER KOVATIS

Editor
A. KORBELAK

Editorial Board
J. M. Andrus, E. R. Bowerman, L. Diveley, F. Fulforth, W. Geissman, D. Gray, W. R. Meyer, L. M. Morse, M. Nadel, C. W. Ostrander

Advisers to the Editorial Board
G. Klinkenstein, H. J. McAleer

Advertising Manager
W. C. DIETRICH

LEE F. O'CONNELL, Western Representative (111 N. LaCienega Blvd., Beverly Hills 48, Calif.; 544 Russ Bldg., San Francisco 4, Calif.)

Production Manager
M. K. DICKINSON

This month's cover is from a photo of the Ontario Research Foundation, Toronto, Ontario, Canada, where the work on AES Research Project No. 14 is being conducted.

Published by the American Electroplaters' Society. Publication Office: 5800 N. Marvine Street, Philadelphia 41, Pa. Phone: LIvingston 8-7800. Editorial, Advertising and Executive Offices: American Building, 445 Broad Street, Newark 2, N. J. Phone: Humboldt 2-3400. Subscriptions: Domestic and Canada, $4.00 for 1 year; $7.00 for 2 years; 50c per copy; Foreign, $8.00 per year; $1.00 per copy.

Copyright, 1954, by the American Electroplaters' Society.

PLATING is abstracted regularly in Chemical Abstracts, Metals Review, Metallurgical Abstracts, Engineering Index, Technical Data Digest and Bulletin Analytique.

Articles appearing in this publication may not be reproduced in full or in part without expressed permission from the Managing Editor.

HARSHAW ANODES and CHEMICALS

You can depend on Harshaw products to keep your production moving. For more than fifty years we have concentrated on improving the quality of the anodes and chemicals used by platers.

NICKEL PLATING

. . . still and barrel . . . nickel anodes—all commercial grades and sizes . . . anode bags . . . single nickel salts—nickel chloride . . . nickel carbonate . . . nickel fluoborate . . . boric acid.

CHROMIUM PLATING

. . . pure "Krome Flake" 99.8% CrO_3 . . . sulphates less than .10% . . . lead, tin-lead and antimony-lead anodes.

COPPER PLATING

. . . copper ball anodes . . . Rochelle Salts . . . sodium and copper cyanides . . . copper sulfate . . . copper fluoborate.

CADMIUM PLATING

. . . ball and cast cadmium anodes . . . cadmium oxide . . . sodium cyanide . . . cadmium fluoborate.

TIN PLATING

. . . cast tin anodes . . . sodium stannate . . . stannous sulfate . . . tin fluoborate . . . acid tin addition agent.

ZINC PLATING

. . . ball and cast zinc anodes . . . sodium and zinc cyanide . . . zinc sulfate . . . zinc fluoborate.

LEAD PLATING

. . . cast lead anodes . . . lead fluoborate.

SILVER PLATING

. . . silver cyanide.

The HARSHAW CHEMICAL Co., Cleveland 6, Ohio

Chicago 10, Ill. • Cincinnati 13, Ohio • Detroit 28, Mich. • Houston 11, Texas
Los Angeles 22, Calif. • Philadelphia 48, Pa. • Pittsburgh 22, Pa. • New York 17, N.Y.

Editorial

Specifications in the Plating Industry

IN THE PRODUCTION of the tremendous volume and variety of consumer and capital goods there is a considerable and valuable contribution made by the plating and metal finishing industry. This wide use of plated and allied finishes attests to the vital importance of the industry in the national production pattern. The high standard of quality that the industry has been able to deliver has played an important part in the acceptance of such coatings.

It is here that the work of the AES, in conjunction with its own Research program and that of other technical groups, has promoted the use of quality coatings on plated parts. Analytical and testing methods, specifications and recommended practices have been issued and many of them have been published in the pages of this journal.

This valuable body of "know-how," that is readily accessible to any supplier or purchaser of plated ware, is overlooked at times. One hears of instances where a plated finish has not given the necessary service. In part, such a situation has been brought about by producers who have revised their service requirements to meet the pressure of competitive business conditions. Such a finish, bought essentially on the basis of price, only serves to discredit the producer and the plating industry.

In a recently reported instance, where price was never a consideration, the supplier of a precious metal finish was not given full engineering data on the requirements of the coating in service. The specified coating thickness was provided, yet the coating failed to perform as needed in an expensive electronic device.

With such examples in evidence, it is felt that a review ought to be made of specifications along with their individually tailored variations. Thickness, smoothness, porosity and color alone may not be enough. There are newer engineering requirements calling for plated coatings with newer service characteristics. For instance, in the electronics industry, one which has grown in a few short years by several billions of dollars, there is a great need for plated coatings requiring special behavior under vacuum, and at high temperatures. Here, a careful review of specifications will again result in a valuable addition to the fund of specification "know-how" which in the past has helped to make plated products look better, serve better and last longer.

Al Korbelak

THE POLAROGRAPHIC ANALYSIS OF NICKEL PLATING SOLUTIONS

J. V. PETROCELLI* AND G. TATOIAN*

Abstract

A brief review is given of polarographic methods and their potentialities in the study and control of plating solutions. The general principles and techniques are outlined and a new manual polarograph is described which has been specifically designed and developed for the application to electroplating solution analysis. Experimental data are presented showing how the polarographic method may be applied to the determination of the principal constituents of the Watts' type nickel plating solution. Standard curves and detailed procedures are given for the determination of nickel sulfate, nickel chloride and boric acid. The effect of *p*H and brighteners is briefly discussed.

Introduction

Polarographic methods of analysis have been used successfully and with great advantage in many fields of applied analytical chemistry. They generally require less chemical manipulation and expenditure of time than the regular chemical methods and are especially useful for the determination of small quantities of substances.

A consideration of the basic principles and techniques involved in polarography indicates that it should lend itself readily and with great advantage to the analysis and the control of plating solutions and electrodeposits. It also should be a very useful tool in plating research. Among the many possible uses of the techniques in this latter field, the following may be mentioned: the mechanism of electrode reactions, adsorption, the study of the potentials at which metals may be reduced from various solutions, the formation of complex ions and their effect on electroplating, and the reaction of brighteners on electrode potentials.

Since the polarographic method is based upon electrochemical phenomena such as electrolysis, polarization, and the measurement of current-voltage curves, it should appeal to the electrochemist and the plater as an elegant and interesting tool for the control and study of his processes.

In light of these attractive features, it is not surprising that interest is increasing in the practical application of polarography to plating control.

Gordon and Roberts[1] have successfully applied the polarograph to the analysis of brass plating solutions and deposits. Sazanova and Korshunov[2] have developed polarographic methods for the analysis of the acid-zinc solution. Vyakhiirev[3] used the polarographic method in developing a procedure for the amperometric titration of sulfates in plating solutions. Recently, Diaz and Lindemann[4,5] have reported methods for the polarographic determination of tin, lead and zinc in their respective plating solutions.

The work reported in this communication is a part of a general study undertaken in the authors' laboratory to develop polarographic methods for the control of some of the more common plating solutions and to design and develop a simplified polarographic instrument which can be used readily by the control chemist. These procedures have been used in the control laboratory of the writers' company for several years with great success. It has been found that the polarographic methods save a considerable amount of time; not only are they much more rapid but the time consumed in making and maintaining the standard solutions usually necessary for the more conventional chemical methods is reduced considerably.

Procedures have been developed for determining the principal constituents of nickel plating solutions, silver, copper, zinc, brass and cadmium-cyanide plating solutions, and chromium plating solutions, and for the detection and determination of some of the impurities usually found in these solutions. The data presented here are concerned with the determination of the principal constituents of a Watts' type and a cold nickel plating solution; it is planned to present data on other plating solutions in subsequent papers.

General Principles

As previously indicated, the principles of polarographic analysis are based upon subjects already fa-

* Director of Research and Chemist, respectively, The Patent Button Company, Waterbury, Conn.

miliar to the electroplater, namely, electrolysis and polarization. Since these fundamentals are treated in great detail in Kolthoff and Lingane's excellent monograph[6] only a very brief outline of the fundamentals will be presented here.

The method is based on the polarization characteristics of a microelectrode when a solution containing an electrooxidizable or an electroreducible substance is electrolyzed. The system consists of a microelectrode and a relatively large nonpolarizable electrode in a solution containing a small concentration (about 10^{-3} M/l) of the substance to be determined, a relatively large concentration (0.1 M/l) of a supporting electrolyte and a small amount of a maximum suppressor such as gelatin.

The most versatile microelectrode is the dropping mercury electrode (D.M.E.) which consists of a capillary glass tube connected to a leveling bulb filled with mercury. The diameter of the capillary and the height of the leveling bulb are adjusted so that the mercury drops from the capillary in small uniform drops. Usually, each drop has a lifetime of about 3 seconds. The nonpolarizable electrode may consist of a large pool of mercury or a calomel half-cell; the saturated calomel half-cell makes a very satisfactory electrode for this purpose. A schematic cell arrangement is shown in Fig. 1.

The substance which is to be determined should be in solution form and a suitable portion added to the supporting electrolyte, gelatin is added and the resulting solution is transferred to the polarographic cell. Since oxygen reacts at the D.M.E. it is desirable to remove dissolved air from the solution by passing nitrogen through it before electrolysis. After shutting off the nitrogen the solution is electrolyzed by slowly applying an increasing voltage. The current is recorded at various values of the applied voltage and the results plotted. This gives the current-voltage curve known as a polarogram. It is then possible to determine the nature and concentration of the reacting substance from the polarogram. The following typical example is given in order to show the technique involved.

As a typical polarographic cell reaction, one may consider the electrolysis of a deaerated solution containing 0.001 M $NiCl_2$, 0.10 N KNO_3 and a small amount of gelatin. The cell and the basic polarizing circuit are shown schematically in Fig. 1.

The basic circuit consists of a uniform slide wire R_2 through which a steady current passes. The total potential drop, V, across the slide wire is adjusted by means of the resistance, R_1, usually at 1.00 v or 2.00 v.

The slide wire contact is moved so as to vary the voltage, E, applied to the cell. Generally, the slide wire has some indicating mechanism such as a graduated dial so that the applied voltage, E, may be read directly. The switch, S, is used for setting the polarity of the dropping mercury electrode. A sensitive galvanometer, G, with its appropriate shunt, R_3, is generally calibrated as a microammeter.

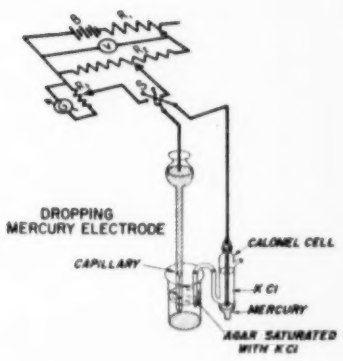


Fig. 1. Schematic polarographic circuit and electrode assembly

If the solution is electrolyzed by making the dropping mercury electrode the cathode and the applied voltage is increased slowly from −0.3 v to −1.5 v at first only a very small current flows, which increases approximately linearly with the voltage and is known as the *residual current.* When the voltage is reached that is high enough for the discharge of nickel ions at the dropping electrode, the current rises very rapidly and finally reaches a *limiting diffusion current.* If the values of the current are plotted versus the corresponding values of the applied voltage, the curve, C, in Fig. 2 will be obtained. This curve is the polarization curve for the deposition of nickel on mercury and is known as a "*polarogram*" or *polarographic wave.* Curve D represents the polarogram for a greater concentration of nickel while curve B represents the wave of lesser concentration.

If the solution did not contain nickel, but only 0.1 M KNO_3, the curve A, in Fig. 2, would be obtained. This consists only of the *residual current* and the difference between curves C and A, at any voltage along

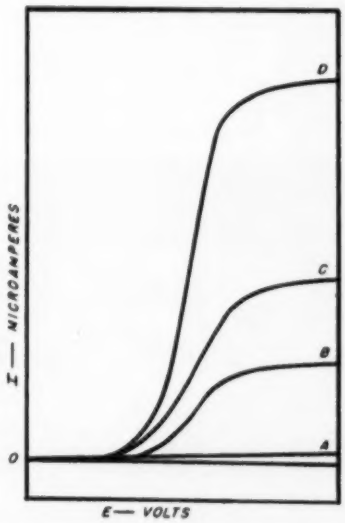


Fig. 2. Schematic polarographic curves. A—residual; B, C and D—various concentrations of reacting ion

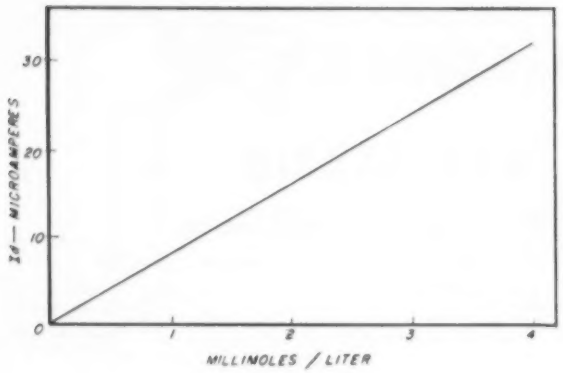


Fig. 3. A schematic calibration curve

the top of the plateau of the wave, is the current increase due to the nickel ion and is called the *diffusion current*, I_d.

The residual current is due predominantly to the flow of current required to maintain the surface charge on the continually renewed surface of the mercury drop.

As each mercury drop grows and falls, the area changes from practically zero to some maximum value. The current, therefore, oscillates between some minimum and maximum value so that the galvanometer spotlight performs oscillations at each current value. For purposes of measurement, maximum values are satisfactory.

The gelatin at a concentration of about 0.01 per cent is necessary in order to suppress the usual tendency of the current-voltage curve to develop an abnormal rise in current before the limiting current is reached.

The diffusion current is due to the extreme state of concentration polarization which is reached at the dropping electrode with respect to the deposition of nickel. Generally, there is a linear relationship between the concentration of nickel in the solution and the diffusion current. Ilkovic[7] derived the following equation for the diffusion current at the dropping mercury electrode at constant temperature:

$$I_d = 607\ n\ D^{1/2} m^{2/3} t^{1/6} C$$

I_d is the limiting diffusion current expressed in microamperes, n is the number of electrons involved in the electrode reaction, D is the diffusion coefficient of the electroactive material in the units $cm^2\ sec^{-1}$, C is the concentration of the electroactive material expressed in millimoles per liter, m is the mass of mercury per drop expressed in mg sec^{-1} and t is the lifetime of a drop in seconds.

This linear relationship is the basis for the application of polarography to quantitative analysis. The qualitative aspects, the identification of the ion, is based on the measurement of the *half-wave potential*, $E_{1/2}$. This is the voltage at which the current has reached one-half the value of the diffusion current. The half-wave potential is characteristic of each ion in any given supporting electrolyte.

If several substances, which undergo reaction at the dropping mercury electrode, are present in the solution, each one will produce its own characteristic polarographic wave. It is thus possible to obtain qualitative and quantitative analysis for several substances in one solution. It is necessary, however, that the half-wave potentials of the substances are not too close together.

Calibration Curves

As shown above, the diffusion current of a substance reacting at the dropping mercury electrode is proportional to the concentration of the substance in any given supporting electrolyte, and given capillary characteristics and temperature. There may be at times some deviations from a linear relationship; it is therefore highly desirable to prepare calibration curves.

A calibration curve should be prepared by running polarograms on a series of test solutions of varying and known concentrations of the substance to be determined. It is absolutely necessary that all other factors remain constant and exactly as these encountered when the unknown is run. These factors are: droptime at a given voltage, supporting electrolyte, concentration of maximum suppressor and temperature. A typical calibration curve is shown in Fig. 3.

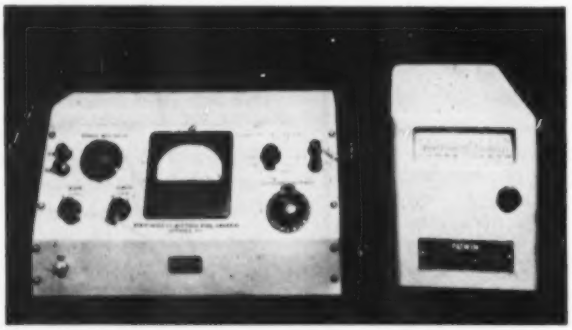


Fig. 4. The Patwin Electro-Polarizer Model C1

Instrumentation

The essential parts of an instrument for obtaining polarographic curves are a polarizing unit by means of which a known and variable voltage may be applied to the cell and a sensitive current measuring device such as a galvanometer.

It soon became apparent during the course of the authors' investigations that a relatively simple manual instrument is all that would be required for the applications to plating solution work. Since most of

the commercial instruments were more elaborate and hence, much more costly than required, a division of the authors' company developed* a unit to overcome such objections. It has been especially designed to meet the requirements at hand; it is simple in its construction and by the elimination of features which are not important to this application its cost was held down to a vicinity that would be attractive to the control chemist and plater. The result was achieved by simplification and not by sacrificing quality of parts; precision components have been used throughout.

The polarizing unit of the instrument contains a 10 turn helical potentiometer with a linearity tolerance of 0.1 per cent and is operated by an integrating dial graduated in one-thousand units. The span voltage may be varied from 1 to 3 volts. With the 3-volt span the accuracy obtained is more than sufficient for polarographic work of this nature. The current is provided by dry cells and regulated by a variable resistor. A voltmeter of 1 per cent accuracy designates the span voltage. A sensitive galvanometer (about 0.005 μa/mm) with a low internal resistance and a long period of swing is used as a microammeter. This is shunted by an 11 point multiplying shunt providing suitable current ranges. A photograph of the instrument is shown in Fig. 4.

Experimental

Apparatus and Materials

The exploratory work and the determination of the calibration curves were performed on a precision manual instrument assembled in the authors' laboratory.* The experiments and actual analyses of plating solutions were carried out with the simplified model which as previously stated had been designed especially for this application. A polarographic cell, also made by the company, in combination with a saturated calomel half-cell was used. The side arm of the calomel cell which serves as a liquid junction was filled with agar gel containing a solution of saturated KCl. The agar plug together with the sintered glass disc in the polarographic cell prevent contamination of the solution by chloride. The cell was immersed in a constant temperature water bath when calibration curves were obtained.

The capillary was made from glass barometer tubing.† It was about 8.0 cm in length with a bore diameter of about 0.06 cm. The constant $m^{2/3}t^{1/6}$ was 1.830 $mg^{2/3}sec^{-1/2}$. The droptime, t, was about 4.5 sec at −1.375 v.

Standard solutions were made up with distilled water and chemically pure salts. The concentrations were determined by standard chemical methods.

The gelatin solution was made by dissolving 0.200 gram of powdered gelatin in 100 ml of distilled water which had been boiled previously for about 10 minutes, and then cooled to 60° C. A few drops of toluene were added and the flask firmly fitted with a glass stopper. All the operations were performed in the flask in which the solution was stored. A solution usually kept for several days. Bacterial action produces a cloudiness which is readily visible and whenever bacterial action was suspected a fresh solution was prepared.

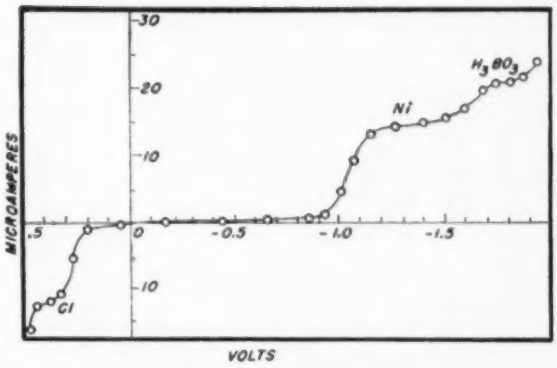


Fig. 5. Polarographic waves for chloride, nickel and boric acid as obtained on a nickel plating solution

Tank nitrogen was used without further purification; this was bubbled through a wash bottle containing distilled water before entering the solution to be polarographed in order to saturate the gas with water.

Supporting Electrolyte

A study of the half-wave potentials of nickel, chloride ion and boric acid indicated that it might be feasible to use one supporting electrolyte for all three constituents. Exploratory experiments showed that 0.1 N KNO_3 (10 g/l) containing 150 g/l of mannitol would be a suitable electrolyte. In this medium a polarogram extending from +0.40 v to −1.90 v yields three waves in succession, the chloride, the nickel and the boric acid wave. The chloride wave is anodic with $E_{1/2} \simeq +0.26$ v while the nickel and boric acid waves are cathodic with $E_{1/2}$ of about −1.07 v and −1.65 v, respectively. A typical polarogram is shown in Fig. 5.

It was found that boric acid does not show a wave in KNO_3 without the presence of mannitol. This is probably due to the fact that boric acid is a very weak acid, and as is well known[8] mannitol forms a relatively strong acid with boric acid.

The concentration of KNO_3 has a definite effect upon the boric acid wave. If the concentration of KNO_3 is greater than about 0.25 N the wave is obscured by the beginning of the much larger potassium wave. The

*Electropolarizer Model C1, manufactured by Patwin Instrument Division, The Patent Button Company, Waterbury, Conn.
†Currently manufactured as Model R1 by Patwin Instruments Division, The Patent Button Company, Waterbury, Conn.
‡Supplied by The Corning Glass Works, Corning, N. Y.

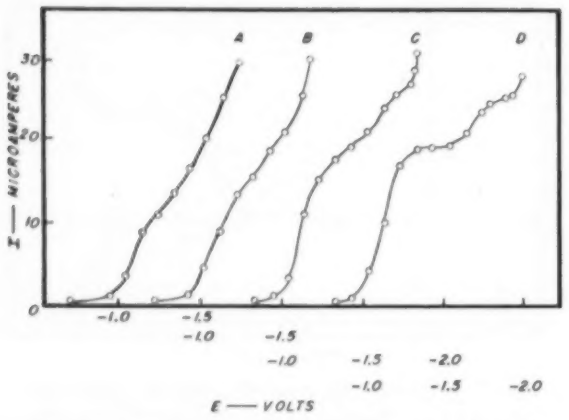


Fig. 6. Effect of KNO_3 concentration on the boric acid wave. A — 1.0 N, B — 0.50 N, C — 0.25 N and D — 0.10 N KNO_3

effect is shown in Fig. 6. As a result of these experiments a solution of 0.1 N KNO_3 containing 150 g/l of mannitol was chosen as a supporting electrolyte.

Deaeration

It is essential to deaerate the solution when nickel and boric acid are being determined. The second wave for the reduction of oxygen occurs in the same region as the nickel wave so that the diffusion current for nickel will be about 1.5 to 2.0 μa too high. The effect on the boric acid is of even greater importance. The hydroxide ion produced by the reduction of oxygen combines with an equivalent amount of hydrogen ion at the electrode surface and low results will be obtained for boric acid.[6]

Since the calomel half-cell contains a high concentration of chloride ion, there is the possibility that some chloride may diffuse into the polarographic cell if sufficient time elapses. It is, therefore, desirable to determine the chloride ion as soon as possible after the half-cell is connected to the polarographic cell. This determination may be performed before the solution is deaerated. The solution may then be deaerated and the nickel and boric acid determined.

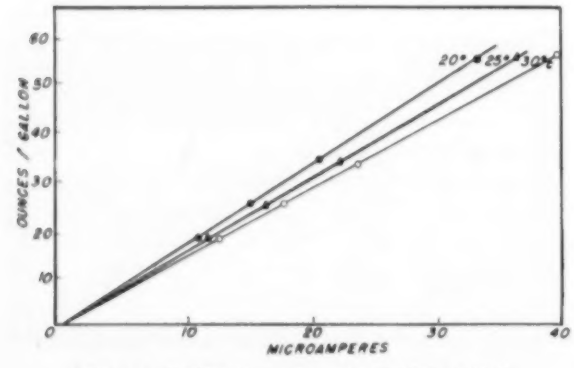


Fig. 7. Calibration curves for $NiSO_4.7H_2O$

Procedures and Calibration Curves

The methods developed in this study are based upon the use of a 0.25-ml sample of plating solution diluted to a final volume of 50 ml for the polarographic solution. This dilution yields a satisfactory concentration (about 1.0 to 10.0 millimoles/l) of reacting substance for polarographic analysis. The concentration of supporting electrolyte is high enough so that either of the two following procedures may be used. A 0.25-ml sample of plating solution may be used directly or a 5.0-ml sample may be diluted to 100 ml with distilled water and a 5.0-ml portion of the resulting solution used.

Calibration curves were obtained as follows: a series of standard solutions were made containing known and varying concentrations of $NiSO_4.7H_2O$, $NiCl_2.6H_2O$ and H_3BO_3. A 5.0-ml sample was diluted to 100 ml with distilled water and a 5.0-ml sample of the resulting solution was pipetted into a 50-ml volumetric flask, 1.0 ml of 0.2 per cent gelatin solution was added and the whole diluted to the mark with supporting electrolyte. About 25 ml of this final solution was transferred to the polarographic cell and nitrogen gas was slowly bubbled through the solution for about 15 minutes and then disconnected. The D.M.E. was then polarized anodically from +0.10 to +0.50 v in order to obtain the chloride wave; and cathodically from −0.70 v to −1.90 v to obtain the nickel and boric acid waves.

Since the waves are well defined and reproducible, the diffusion currents were obtained by pointer readings. The currents were read at +0.40 v for chloride, −1.38 v for nickel and −1.82 v for boric acid. A correction was not made for the residual current, therefore this current appears as the intercept of the calibration curves on the current axis. The calibration curves were obtained at three temperatures, 68°, 77° and 86°F.

All concentrations are reported as those in the sample, e.g., the plating solution; where the total nickel content as obtained from the polarogram is expressed as $NiSO_4.7H_2O$, the total chloride content as $NiCl_2.6H_2O$ and the boric acid as H_3BO_3. It should be noted that in order to obtain the actual concentrations of $NiSO_4.7H_2O$ a correction must be applied for that portion of the nickel present as $NiCl_2.6H_2O$. This is the usual correction which is applied when standard chemical methods are used.

Calibration curves are shown in Figs. 7, 8 and 9. The numerical values are given in Table I; where the diffusion current has been corrected for the residual current. It will be seen that a good linear relationship between current and concentration is shown for all three constituents.

Effect of pH

It was found that if the *p*H of the plating solution

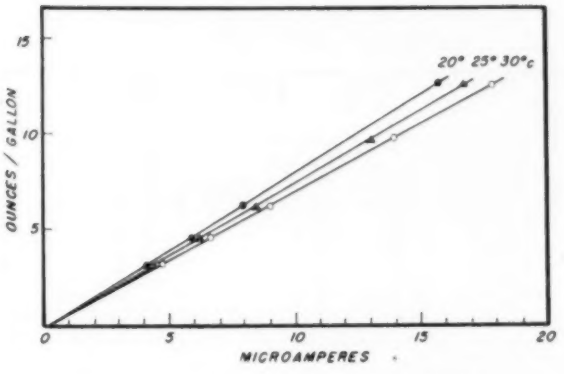


Fig. 8. Calibration curves for $NiCl_2.6H_2O$

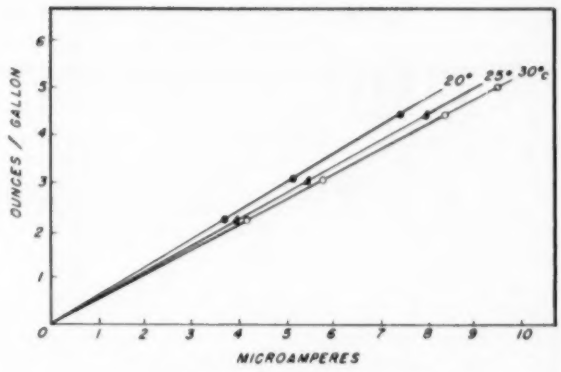


Fig. 9. Calibration curves for H_3BO_3

is lower than about 3.0, the results for boric acid are too high. Polarograms run on solutions which did not contain boric acid showed that a "hydrogen" wave is obtained when the *p*H is lower than 3.0.

Although it is possible to make a correction for the "hydrogen" wave, it appeared more desirable to neutralize the strong acid prior to running the boric acid polarogram. The following modification was therefore introduced into the procedure when the *p*H of the plating solution is below 3.0. After the sample of plating solution is pipetted into the 50-ml volumetric flask, the flask is only partially filled with the supporting electrolyte; a few drops of bromphenol blue are added and then a solution of NaOH (about 0.1 N) is slowly added dropwise until the indicator just changes color (from yellow to blue). Then 1 ml of 0.2 per cent gelatin is added and the solution is diluted to the mark with more supporting electrolyte. The polarograms then are run as usual.

Effect of Brightening and Other Addition Agents

Although it was not possible to examine the effect

TABLE I. DIFFUSION CURRENT CONSTANTS FOR PRINCIPAL CONSTITUENTS OF A NICKEL PLATING SOLUTION*

Constituent	Concentration in Plating Solution oz/gal	Diffusion Current I_d Microamperes			Constant Microamperes per oz/gal		
		86° F	77° F	68°F	86° F	77° F	68° F
$NiSO_4.7H_2O$	18.3	12.98	11.9	10.7	0.710	0.650	0.585
	25.8	18.2	16.3	11.9	0.705	0.632	0.578
	36.9	26.3	24.2	21.9	0.713	0.656	0.594
	55.3	39.0	35.8	32.2	0.705	0.647	0.582
					Average 0.708	0.646	0.585
$NiCl_2.6H_2O$	3.16	4.30	4.14	3.97	1.36	1.31	1.26
	4.41	6.11	5.75	5.36	1.39	1.30	1.22
	6.30	8.80	8.18	7.60	1.40	1.30	1.21
	12.67	17.6	16.4	15.4	1.39	1.29	1.22
					Average 1.39	1.30	1.23
H_3BO_3	2.19	4.20	3.85	3.68	1.92	1.76	1.68
	3.07	5.80	5.60	5.24	1.89	1.82	1.71
	4.40	8.20	7.90	7.40	1.86	1.80	1.68
	6.58	12.4	———	———	1.89	———	———
					Average 1.89	1.79	1.69

*$m^{2/3}t^{1/6} = 1.83\ mg^{2/3}sec^{-1/2}$. Values are for 0.25 ml of plating solution diluted to final volume of 50 ml.

TABLE II. COMPARISON OF ANALYTICAL RESULTS AS OBTAINED BY POLAROGRAPHIC AND STANDARD CHEMICAL METHODS*

$NiSO_4.7H_2O$		$NiCl_2.6H_2O$		H_3BO_3	
Chemical Method	Polarographic Method	Chemical Method	Polarographic Method	Chemical Method	Polarographic Method
oz/gal		oz/gal		oz/gal	
29.6	29.4	4.8	5.0	3.9	3.6
30.6	30.8	4.8	4.8	3.7	3.5
29.0	29.2	7.3	7.6	3.8	3.7
30.4	30.4	6.6	6.7	3.9	3.8

*Representative values obtained with a production nickel plating solution.

of all the commercial brighteners, the effect of several of the more common ones was determined. It was found that only one of those examined had any appreciable effect: it caused high results for the boric acid. The result, however, is also too high when conventional chemical methods are used and is due to the presence of boric acid in the brightener.

The procedure was used on a bright cobalt-nickel bath[9] and yielded satisfactory results.

No significant effects on the results were found when wetting agents, hydrogen peroxide or both were added to the bath.

Discussion

As previously indicated, the above methods have been used successfully in the control laboratory of the authors for several years to control both a Watts' type solution and a plain cold nickel solution containing ammonium chloride. Generally, it has been found that the precision for the nickel and chloride determination is about 2 per cent. Since the diffusion current for boric acid is about one-third that for nickel and occurs after the nickel wave, the precision in this case is somewhat lower. A comparison of the polarographic results with those obtained by the conventional chemical methods shows that they generally agree to within about ±0.25 oz/gal. The values shown in Table II were chosen at random and are representative.

It should be pointed out that it is not necessary to make special solutions in order to obtain calibration curves. If one wishes to set up the polarographic methods, a very convenient and satisfactory procedure is to use the plating bath with its known composition as a primary standard. Suitable samples of the plating bath may be diluted in such a manner that the resulting solutions will represent various concentrations of the constituents. Polarograms may be run on each dilution and a calibration curve plotted.

Acknowledgment

The authors wish to express their appreciation to Miss E. Lawler and Mr. D. Lake who assisted in performing the experimental work reported in this study.

Bibliography

[1]H. E. Zentler Gordon and Eric R. Roberts, Trans. Electrochem. Soc. **90**, 27 (1946).

[2]I. A. Korshunov and L. N. Sazanova, C. A. **42**, No. 22, 8701 (1948).

[3]D. A. Vyakhirev, C. A. **40**, No. 10, 2759 (1946).

[4]R. Diaz, Plating **40**, 45, 261 (1953).

[5]R. Diaz and E. H. Lindemann, Plating **40**, 762 (1953).

[6]I. M. Kolthoff and J. J. Lingane, "Polarography" 2nd Edition, Interscience Publishers, N. Y. (1952).

[7]D. Ilkovic, C. A. **29**, No. 9, 2858 (1935).

[8]M. Hollander and W. Rieman, III, Ind. Eng. Chem. (Anal. Ed.) **17**, 602 (1945).

[9]W. Blum and G. B. Hogaboom, "Principles of Electroplating and Electroforming" 3rd Edition, McGraw-Hill Book Co., Inc., New York (1949).

THE USE OF UNPLASTICIZED POLYVINYL CHLORIDE IN ELECTROPLATING PLANTS

LAURENCE N. THOMAS*

Introduction

The unwieldy name, unplasticized polyvinyl chloride, describes a material that is often better known by its trade name. This material means much in end results. To facilitate the following discussion it is used in the abbreviated form—PVC.

Unplasticized PVC was developed in Germany for commercial use during World War II as a substitute for metals, especially those which make up the corrosion resistant alloys. Determination of the physical and chemical behavior of this material was made for every imaginable use, and it was finally found that unplasticized polyvinyl chloride had established its own position in the field of corrosion resistant materials.

The point should be brought out here that unplasticized PVC is practically pure resin and is in a category by itself. It should not be confused with the so-called "rigid" or "plasticized" PVC's, which usually have lower physical and chemical properties in corrosion resistance structural application. A listing of the chemical resistance of unplasticized PVC towards aqueous inorganic chemicals and to some of the organics is given in Table I. Here it is seen that the resistance is nonexistent toward some, doubtful towards others and good toward still other compounds. Most aldehydes, ketones, esters, ethers, and chlorinated hydrocarbons will attack unplasticized PVC readily. Other organics cause less severe swelling but subsequent weakening. Long chain hydrocarbon and high hydroxyl content compounds have little or no effect on unplasticized PVC. In general, resistance decreases with heat, especially above 150° F. Of course, increased temperatures affect metals and other materials in corrosion resistance applications.

Unplasticized PVC in the Plating Department

Unplasticized PVC is selected by the plater for its basic physical and chemical properties, its general processability, and its fabricating possibilities such as turning, drilling, sawing, forming, molding, and welding.

Approximately four years ago, the first installation of unplasticized PVC of any size was made in this country in an electroplating plant. At that time, a foreign PVC was used, as the American materials had not been developed.

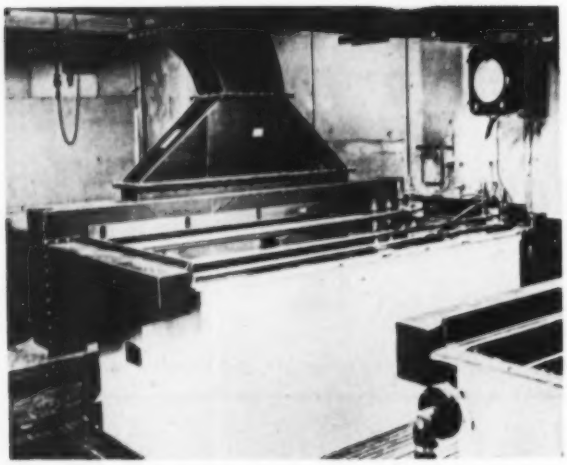
The decision to use unplasticized PVC had to be made by a man with a pioneering spirit, because it was a new and untried material as far as the United States was concerned. Also it was being offered by a small organization that was a pioneer itself in this field. The problem at that time was the replacement of plenum chambers and duct work in a plating room of one of the largest radio manufacturing companies in America. For many years, the commonly accepted materials were used for ducts and their mortality rate was very high. The decision was made to try this "new" material—unplasticized PVC. Sheet metal design was followed closely, and all of the required plenum chambers and ducts were made and installed for both acid and alkali tank equipment. From Figs. 1 and 2, it can readily be seen that the duct work appears to be much like steel—even the bolts and nuts that hold the flanged sections together are unplasticized PVC. This installation, which replaces the one shown in Fig. 3, has now been in operation for three years, and there is no indication of any deterioration.

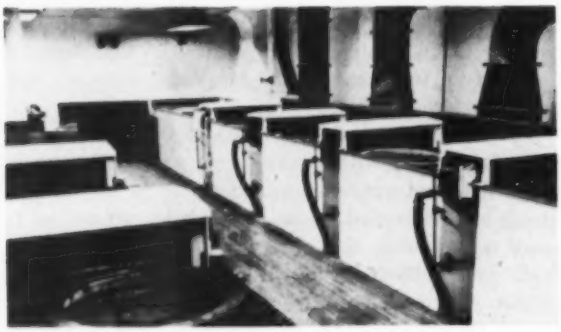
Service Life of the Material

The expected life of unplasticized PVC fabrications cannot be judged by installations made in this country because of the relative newness of this product, but listed below are a few typical installations that have been in operation in Germany.

(1) hydrochloric acid, 4-inch diameter pipe line operating at a temperature of 140° F outdoors for three years—no deterioration
(2) sulfuric acid piping, duct work, and ventilating fan—thirteen years—no deterioration
(3) nitric acid, 10-foot high storage tank—five years—no deterioration

*H. N. Hartwell & Son, Inc., Boston 16, Mass.





Figs. 1 and 2. Fume exhaust system for plating room fabricated of unplasticized PVC. In service four years at Radio Corporation of America, Camden, N. J.

(4) nitric-sulfuric-hydrofluoric pickling acid storage tank—thirteen years—no deterioration
(5) chlorinization column, 12 feet high—two years—no deterioration
(6) chemical plant atmosphere—drain pipe and gutters—seven years—no deterioration
(7) chemical laboratory sink and valve, piping, hood and duct work—four to ten years—no deterioration.

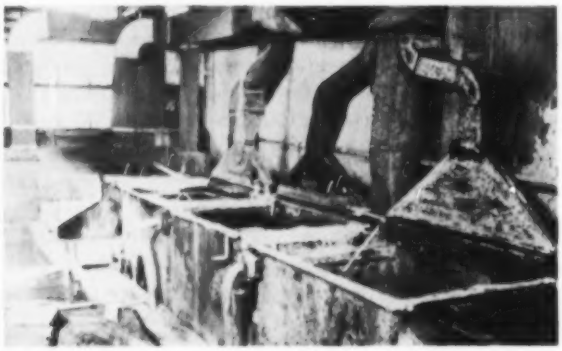


Fig. 3. Fume exhaust system and plating room prior to reconstruction with unplasticized PVC

TABLE I. CHEMICAL RESISTANCE OF UNPLASTICIZED POLYVINYL CHLORIDE

Reagent	Temperature	
	72° F	140° F
A		
Acetaldehyde	NR	NR
Acetic acid, 10%	R	R
Acetic acid, glacial	R	NR
Acetic anhydride	NR	NR
Acetone	NR	NR
Adipic acid	R	R
Allyl alcohol 96%	R	NR
Allyl chloride	NR	NR
Alum	R	R
Aluminum chloride	R	R
Aluminum fluoride	R	R
Aluminum hydroxide	R	R
Aluminum oxychloride	R	R
Aluminum nitrate	R	R
Aluminum sulfate	R	R
Ammonia (gas)	R	R
Ammonia (liquid)	NR	NR
Ammonium bifluoride	R	R
Ammonium carbonate	R	R
Ammonium chloride	R	R
Ammonium fluoride 25%	R	NR
Ammonium hydroxide 28%	R	R
Ammonium metaphosphate	R	R
Ammonium nitrate	R	R
Ammonium persulfate	R	R
Ammonium sulfate	R	R
Ammonium sulfide	R	R
Ammonium thiocyanate	R	R
Amyl acetate	NR	NR
Amyl chloride	NR	NR
Aniline	NR	NR
Aniline hydrochloride	NR	NR
Anthraquinone	R	
Anthraquinonesulfonic acid	R	R
Antimony trichloride	R	R
Aqua regia	R	R
Arsenic acid 80%	R	R
Arylsulfonic acid	R	NR
B		
Barium carbonate	R	R
Barium chloride	R	R
Barium hydroxide	R	R
Barium sulfate	R	R
Barium sulfide	R	R
Benzaldehyde	NR	NR
Benzene	NR	NR
Benzoic acid	R	R
Bismuth carbonate	R	R
Borax	R	R
Boric acid	R	R
Bromic acid	R	R
Bromine, liquid	NR	NR
Bromine, water	R	R
Butane	R	
Butadiene	R	R
Butanol, primary	R	R
Butanol, secondary	R	NR
Butyl acetate	NR	NR
Butyl phenol	R	NR

TABLE I. CHEMICAL RESISTANCE OF UNPLASTICIZED POLYVINYL CHLORIDE (Continued)

Reagent	Temperature 72° F	Temperature 140° F
B		
Butylene	R at 0° F	
Butyne diol	R	NR
Butyric acid	NR	NR
C		
Calcium carbonate	R	R
Calcium chlorate	R	R
Calcium chloride	R	R
Calcium hydroxide	R	R
Calcium hypochlorite	R	R
Calcium nitrate	R	R
Calcium sulfate	R	R
Carbonic acid	R	R
Carbon bisulfide	NR	NR
Carbon dioxide	R	R
Carbon monoxide	R	R
Carbon tetrachloride	R	NR
Cellosolve	R	R
Chloracetic acid	R	R
Chloral hydrate	R	R
Chloric acid 20%	R	R
Chlorine (gas)	R	NR
Chlorine, water	R	R
Chlorobenzene	NR	NR
Chloroform	NR	NR
Chlorosulfonic acid	R	
Chrome alum	R	R
Chromic acid 40%	R	R
Citric acid	R	R
Copper chloride	R	R
Copper cyanide	R	R
Copper fluoride	R	R
Copper nitrate	R	R
Copper sulfate	R	R
Cresol	NR	NR
Cresylic acid 50%	R	R
Croton aldehyde	NR	NR
Cyclohexanol	NR	NR
Cyclohexanon	NR	NR
D		
Dextrin	R	R
Dextrose	R	R
Diazo salts	R	R
Diglycolic acid	R	R
Dimethylamine	NR	NR
Dioctylphthalate	NR	NR
E		
Ethyl acetate	NR	NR
Ethyl acrylate	NR	NR
Ethyl alcohol	R	R
Ethyl chloride	NR	NR
Ethyl ether	NR	NR
Ethylene bromide	NR	NR
Ethylene chlorhydrin	NR	NR
Ethylene dichloride	NR	NR
Ethylene glycol	R	R
Ethylene oxide	NR	NR
F		
Fatty acids	R	R
Ferric chloride	R	R
Ferric nitrate	R	R
Ferric sulfate	R	R
F		
Ferrous chloride	R	R
Ferrous sulfate	R	R
Fluorine (gas)	R	R
Fluorosilicic acid	R	R
Formaldehyde	R	R
Formic acid	R	NR
Fructose	R	R
Furfural	NR	NR
G		
Glucose	R	R
Glycerine	R	R
Glycol	R	R
Glycolic acid	R	R
H		
Hexanol, tertiary	R	R
Heptane	R	R
Hydrobromic acid 20%	R	R
Hydrochloric acid 35%	R	R
Hydrochloric acid 10%	R	R
Hydrocyanic acid	R	R
Hydrofluoric acid 48%	R	NR
Hydrogen	R	R
Hydrogen peroxide 90%	R	R
Hydrogen phosphide	R	R
Hydrogen sulfide	R	R
Hydroxylamine sulfate	R	R
Hypochlorous acid	R	R
I		
Iodine	NR	NR
K		
Kerosene	R	R
L		
Lactic acid	NR	NR
Lard oil	R	R
Lauric acid	R	R
Lauryl chloride	R	
Lead acetate	R	R
Linoleic acid	R	R
Linseed oil	R	R
M		
Magnesium carbonate	R	R
Magnesium chloride	R	R
Magnesium hydroxide	R	R
Magnesium nitrate	R	R
Magnesium sulfate	R	R
Malic acid	R	
Maleic acid	R	R
Mercuric chloride	R	R
Mercuric cyanide	R	R
Mercurous nitrate	R	R
Mercury	R	R
Methyl alcohol	R	R
Methyl chloride	NR	NR
Methyl ethyl ketone	NR	NR
Methyl sulfate	R	R
Methyl sulfuric acid	R	R
Methylene chloride	NR	NR
Mixed acid	R	R

TABLE I. CHEMICAL RESISTANCE OF UNPLASTICIZED POLYVINYL CHLORIDE (Continued)

Reagent	Temperature 72° F	Temperature 140° F
N		
Naphtha	R	R
Naphthalene	NR	NR
Nickel chloride	R	R
Nickel nitrate	R	R
Nickel sulfate	R	R
Nicotine	R	R
Nicotinic acid	R	R
Nitric acid, anhydrous	NR	
Nitric acid 68%	R	R
Nitric acid 10%	R	R
Nitrobenzene	NR	NR
Nitrous oxide	R	R
O		
Ocenol (Unsaturated Alcohol)	R	R
Oils and Fats	R	R
Oleic acid	R	R
Oleum	NR	
Oxalic acid	R	R
Ozone	R	R
P		
Palmitic acid	R	R
Perchloric acid 70%	R	NR
Perchloric acid 10%	R	NR
Phenol	R	NR
Phenylhydrazine	NR	
Phenylhydrazine hydrochloride	R	NR
Phosgene, liquid	NR	
Phosgene, gas	R	
Phosphoric acid 85%	R	R
Phosphoric acid 10%	R	R
Phosphorus (yellow)	R	
Phosphorus pentoxide	R	
Phosphorus trichloride	NR	
Picric acid	NR	NR
Potassium bicarbonate	R	R
Potassium bichromate	R	R
Potassium borate	R	R
Potassium bromate	R	R
Potassium bromide	R	R
Potassium carbonate	R	R
Potassium chromate	R	R
Potassium chlorate	R	R
Potassium cyanide	R	R
Potassium ferricyanide	R	R
Potassium ferrocyanide	R	R
Potassium fluoride	R	R
Potassium hydroxide	R	R
Potassium nitrate	R	R
Potassium perborate	R	R
Potassium perchlorite	R	R
Potassium permanganate 10%	R	R
Potassium persulfate	R	R
Potassium sulfate	R	R
Propane	R	
Propargyl alcohol	R	R
Propyl alcohol	R	R
Propylene dichloride	NR	NR

Reagent	Temperature 72° F	Temperature 140° F
S		
Sea water	R	R
Selenic acid	R	
Silicic acid	R	R
Silver cyanide	R	R
Silver nitrate	R	R
Sodium acetate	R	R
Sodium benzoate	R	R
Sodium bicarbonate	R	R
Sodium bisulfate	R	R
Sodium bisulfite	R	R
Sodium bromide	R	R
Sodium carbonate	R	R
Sodium chlorate	R	R
Sodium chloride	R	R
Sodium cyanide	R	R
Sodium ferricyanide	R	R
Sodium ferrocyanide	R	R
Sodium fluoride	R	R
Sodium hydroxide	R	R
Sodium hypochlorite	R	R
Sodium nitrate	R	R
Sodium nitrite	R	R
Sodium sulfate	R	R
Sodium sulfide	R	R
Sodium sulfite	R	R
Stannic chloride	R	R
Stannous chloride	R	R
Stearic acid	R	R
Sulfur	R	R
Sulfur dioxide (gas)	R	R
Sulfur dioxide (liquid)	R	NR
Sulfur trioxide	R	R
Sulfuric acid 94%	R	R
Sulfuric acid 80%	R	R
Sulfuric acid 33%	R	R
Sulfurous acid	R	R
T		
Tannic acid	R	R
Tartaric acid	R	R
Tetraethyl lead	R	
Tetrahydrofurane	NR	NR
Thionyl chloride	NR	
Toluol	NR	NR
Tri butyl phosphate	NR	NR
Trichloroethylene	NR	NR
Triethanolamine	R	R
Triethylamine	R	R
Trimethyl propane	R	R
Trisodium phosphate	R	R
Turpentine	R	R
U		
Urea	R	R
Urine	R	R
V		
Vinyl acetate	NR	
Z		
Zinc chloride	R	R
Zinc sulfate	R	R

TABLE II. PROPERTIES OF UNPLASTICIZED PVC

	ASTM Method	Unplasticized PVC	Polyethylene	Polyvinylidene Chloride
Specific Gravity	D792–48T	1.4	0.9	1.7
Tensile Strength—psi	D638–49T	8700	2500	5000
Modulus of Elasticity in Tension—psi	D638–49T	$4–5 \times 10^5$	2×10^4	0.8×10^5
Flexural Strength—psi	D671–49T	16,000	1700	16,000
Compressive Strength—psi	D695–49T	10,000	—	8000
Hardness (Rockwell)	D785–48T	M–60	R–11	M–60
Heat Distortion °F—66 psi (Maximum Useful Temperature)	D648–45T	165° F	120° F	160° F
Coefficient of Expansion per 1° C	D694–44	8×10^{-5}	4×10^{-4}	16×10^{-5}
Thermal Conductivity Cal/sec/sq cm/cm/° C	C–177	4×10^{-4}	8×10^{-4}	3×10^{-4}
Specific Heat Cal/gm/° C	Calorific Method	0.24	0.55	0.32
Flammability	D568–48	Self Ext.	Burns	Self Ext.
Dielectric Constant at 1 megacycle	D150–47T	3	2.3	4
Water Absorption % 24 hrs at 25° C	D570–42	0.05	0.01	0.05

Applications for the Material

Table II has been designed to help the reader in his analysis of unplasticized PVC. It will be noted that physical properties are listed for polyethylene and polyvinylidene chloride, but particular attention is called to the tensile strength and the heat distortion comparison. Unplasticized PVC is the most rigid of the three materials.

Listed below are several suggested applications with a general discussion to indicate the possible uses of unplasticized PVC as it applies to the plating room.

1. Small special purpose tanks for plating, etching, or pickling are easily produced by a fabricator of unplasticized PVC. These tanks can be made with special overflow, inlet, or bottom drains, all welded for permanency, but at the same time, the tank can be altered to suit changing needs with no more trouble than if they were made of steel. When made of unplasticized PVC, these tanks can handle readily not only acids and mixed acids but also alkalies.

2. Large lined tanks that must be protected with a corrosion resistant material can readily be worked out by using a "slip in" liner, or a job can be done in the field by a fabricator. With these linings, special precautions must be taken to overcome the differential in expansion of unplasticized PVC and steel. There are such tanks for acids or alkalies with allowable working temperatures up to 160° F. Linings will be rigid and hard, and therefore more resistant to mechanical damage than the soft linings. If damaged, repairs can be made readily by cutting out the damaged portion and rewelding a patch in its place.

3. Within the temperature limitation, unplasticized PVC pipe and fittings are the answer for plating solution agitation; either by air, recirculation from a filter setup, or for pumping of acids or plating solutions. As there are valves made of this material, permanent piping layouts can be made with bypass setup for priming tanks and

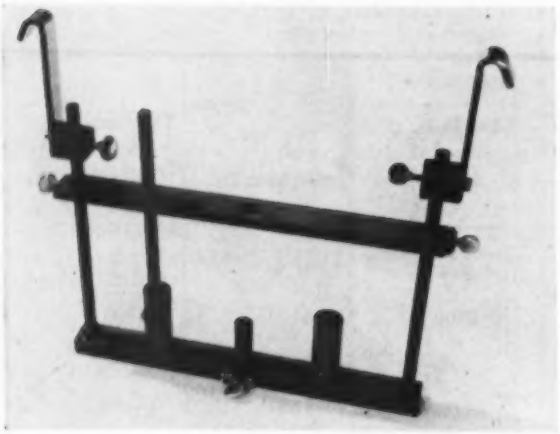


Fig. 4. A special plating rack manufactured completely of unplasticized PVC except for the metal thumb screws and plates

storage tanks, which also can be manufactured of unplasticized PVC.

4. Special electroplating racks, as illustrated in Fig. 4, are a new application for unplasticized PVC. Because of the resistance of unplasticized PVC to chromic acid, its excellent machineability, and its electrical insulating value, it is an ideal material for the construction of plating racks that require complicated setup of special anode rigging. In the hard chromium plating field, in particular, insulating materials have been required, and because of the oxidizing nature of chromic acid, most materials that are at all easy to handle are not sufficiently resistant to acids and alkalies. In unplasticized PVC, electroplaters have material in sheet, block, rod, and pipe form that is highly acid resistant, that can be machined, drilled, tapped, cemented, formed and even welded to make up practically any shape required. As with any new mechanical operation a certain amount of training in the handling of the material is required to realize maximum efficiency in its use. Fig. 4 is a special plating rack manufactured completely of unplasticized PVC except for the metal thumb screws and plates.

The following advantages should be considered as a whole when evaluating unplasticized PVC. It is a material that should be considered to do a certain job even for only one of its particular outstanding physical properties.

1—Resistance to acid and alkalies—This includes the oxidizing acids, such as chromic, nitric, and mixed acids for bright dip and stainless steel pickling.

2—Long Life—Because unplasticized PVC is made from a "pure" resin, without the inclusion of plasticizers, and is not a copolymer (a material basically PVC, but with additives to aid workability which lowers the physical and chemical properties), the service-life expectancy is extended.

3—High Temperature—In the field of thermoplastics, unplasticized PVC has good heat stability (up to 160° F) and compares favorably with most plastics.

4—Machineability—One of the better plastics for machine work, unplasticized PVC can be turned, drilled, sawed, and handled with many of the normal machine tools or wood-working equipment within a close tolerance.

5—Forming—Because unplasticized PVC is thermoplastic, forming can be done with a male and female die; sometimes with the use of a vacuum die, after heating a sheet in an oven to the proper temperature. For simple forming needs such as a bend, localized heating can be used.

6—Hot Jet Welding—Because unplasticized PVC now can be welded, it becomes a material that has a wide latitude in structural design. The welding technique is one of the most important elements of fabrication. Intensive training is necessary to produce good, high quality, high strength welds. Most suppliers of this material have gone to a great deal of trouble to train personnel in the proper art of welding in order to assure a good, final, fabricated product.

7—Full Range of Material—Unplasticized PVC manufactured in this country is now available in sheet form from 1/32 inch thickness to 1 inch thickness; in solid rod stock in diameters of ¼ inch to 2 inches; in block stock 12 inches square 2, 3, and 4 inches thick; pipe ¼ to 4 inches standard IPS, outside diameter; pipe fittings molded for ¼ to 2 inch pipe; and welding rod.

8—Trained Fabricators—There are now many qualified fabricators of unplasticized PVC throughout the United States. These organizations have learned the technique required to design and produce fabricated parts economically for use in the corrosion field.

Summary

In conclusion, the plating industry has in unplasticized PVC a new material with a proven past history. This history covers fifteen years' experience in the chemical industries abroad as a corrosion resistant material. It is hoped, through this discussion, that other new uses and applications will be suggested to users of chemical processing and allied equipment.

INDUSTRIAL WASTE CONTROL

D. GARDNER FOULKE*

Both the technical and lay press currently are devoting considerable linage to pollution problems. At the same time pressure is increasing throughout the country for abatement, both with respect to effluents emptied into streams and municipal sewage systems and gases and their entrained solids and liquids spewed into the air. Fortunately, the latter problem is not a serious one for the electroplating industry, so that developments in air pollution will not be covered in this short review.

NTTCIW Meeting

At a recent meeting of the National Technical Task Committee on Industrial Wastes, it was reported that there were 405 research projects currently under way on waste problems. Of these, 131 were sponsored by industry, 180 by universities and research foundations and 94 by government agencies. This very considerable amount of research—and the report was by no means complete—testifies to the effort being devoted to the problem of stream pollution abatement. In the metal finishing field there are a number of research projects specifically directed towards waste treatment problems. These include AES Project No. 10, and work sponsored by the Metal Finishing Action Committee of the Ohio River Valley Water Sanitation Commission, including a literature study of the toxicity limits of metal finishing wastes to man, animals and aquatic life which is being evaluated by the Kettering Laboratory and the Aquatic Life Advisory Committee (ORSANCO). Other projects include studies on the toxicity of complex cyanides to fish at the Environmental Health Center, Cincinnati, Ohio, aluminum plant effluents at the State College of Washington, the concentration of metal ions and the regeneration of magnesium pickling solutions at the University of Detroit and the effect of plating wastes on the operation of sewage treatment plants at Michigan State College and Ohio State University. In addition, a number of studies have been made by (1) companies which have found it necessary to take steps to eliminate pollution and by (2) suppliers to industry of waste disposal equipment.

Functions of the NTTCIW

The National Technical Task Committee on Industrial Wastes came into being as the result of the passage of the Federal Water Pollution Control Act (PL 845) in 1948. The Task Committee provides the means for industry cooperation in the matter of water pollution control. It consists of representatives of those industries which have an industrial waste problem—from automotive to rubber and including electroplating and metal finishing. The functions of the committee are:

1. To inventory, appraise, coordinate and promote research and development work on utilization, treatment and control of industrial wastes.
2. To facilitate securing uniformity in methods of measuring and evaluating trade wastes in water quality control.
3. To stimulate more effective working relationships on technical phases of the work of improving the quality of waters between industry and federal, state and local government agencies.
4. To help point up the activities on industrial wastes of the Environmental Health Center.
5. To aid in establishing, where major needs exist, for any grants-in-aid for obtaining basic information relative to taking care of the industrial waste problems in water pollution control.
6. To stimulate further adoption of practical methods now known and to be developed for minimizing and treating wastes in effecting stream improvement.
7. To secure wide dissemination of information on technical progress and what is being accomplished by various branches of industry, maintain suitable contacts with technical societies, professional organizations, trade associations and other such groups issuing publications that reach those concerned with pollution problems.
8. To aid in promoting such training activities as necessary to facilitate efficient operation of waste recovery and treatment systems in industry.
9. To perform such other technical tasks pertaining to industrial effluents as appropriate to stimulate

*Manager of Electrochemical Research, Hanson-Van Winkle-Munning Co., Matawan, N. J.

improvement in the quality of the water resources of the nation.

The NTTCIW has contributed much towards solving the problem of water quality control. Quoting Mr. L. A. Danse of the General Motors Corp., one of the leaders in the electroplating field on the problem of industrial waste control, "Industry functioning is in in high gear and is really making progress. The Task Committee is largely responsible for the improved conditions."

Trends in Waste Disposal Control

Trends in the field of electroplating and metal finishing continue to be:

1. The reduction of the quantity of waste.
2. The conservation of water.

The reduction of the quantity of wastes has been accomplished by the use of save rinses, elevation of conveyor carrier arms for a number of stations at the end of the plating tank with or without fog rinses, the use of ion-exchange systems and in some cases by enlisting the aid of the design engineer to provide for drainage from the part thus to minimize drag-out.

The conservation of water has been accomplished by use of ion-exchange equipment, the use of spray rinsing, injection of air into rinse tanks, and the use of only as much water as is shown to be required.

Work of ORSANCO

The Ohio River Valley Water Sanitation Commission has probably done more towards solving the problem of stream pollution in the last five years than any other body. Established as the result of an eight-state compact approved by the Congress of the United States, ORSANCO already has completed investigations, held hearings, adopted regulations for sewage discharges and issued notices of compliance for half the 981-mile Ohio River. On the industrial front progress also has been made. Of the 1,247 industries discharging directly into Ohio River valley streams, 817 are now operating control facilities, 31 are constructing facilities and 117 are completing plans for waste treatment works. Substantial quantities of industrial waste are, of course, being treated in municipal disposal plants. As a matter of policy, the Ohio River Valley Water Sanitation Commission recognizes that the industries of the area have a major stake in the water resources of the region and at the start encouraged the formation of industry-advisory committees. The Metal Finishing Committee has prepared four manuals* as follows: "Planning and Making Industrial Waste Surveys," "Plating Room Controls for Pollution Abatement" (1951), "Methods for Treatment of Metal-Finishing Wastes" (1953) and "Methods for Analysis for Metal Finishing Wastes" (on press). For the last publication some of the preliminary analytical studies were done by AES Project No. 2 under Dr. Serfass at Lehigh University and the final methods were developed there under an ORSANCO grant and are being published only after industrial field tests were made.

The method used to combat pollution in the Ohio River valley appears to be setting a pattern. A seven-state compact has been proposed to curb pollution in the waters of the Tennessee River basin. Another is proposed for the Sabine River basin involving Texas and Louisiana. Other bodies include Incodel (Delaware River), the New England Interstate Water Pollution Commission and the International Joint Commission (United States and Canada).

State and Federal Legislation

Recent legislative action includes a Connecticut law forbidding a company to create a new source of pollution without obtaining a permit. The Illinois legislature authorized the organization of surface water protection districts and Indiana's Stream Pollution Control Board has approved industrial plans to prevent the accidental discharge of cyanide solutions. In view of the general trend to require abatement of surface water pollution three bills being considered by Congress (H.R. Nos. 234, 606, 2535) are of particular interest. All three of these bills propose that industrial waste treatment works be charged off for tax purposes at an accelerated rate in order to encourage the prevention of water pollution.

The Water Pollution Control Act of 1948 recognized the right of the States to control pollution. Consequently, legal requirements vary from state to state. The trend is, however, to base control upon the concept that water pollution should not be allowed to interfere with water uses important to an area. This has been variously called "total use," "best use" and "most appropriate use," but, whatever the name chosen, it is necessary to obtain a full knowledge of the stream before the problem can be adequately defined and a program formulated. This points up also the importance of the condition of the river at the point of effluent emptying as well as possible recovery by the time the water has reached any given point downstream. As a result of the "most appropriate use" concept the "stream classification" device has been adopted by many states as an administrative assist.

Other terms used in recently adopted legislation and regulations include "objectives," "criteria" and "standards." "Objective" denotes the goal of a program administration, suggesting a desirable end to be met. The word "standard" has a more rigid legal connotation and carries with it the idea of immediate legal compliance. However, the actual rigidity of many of the standards set up is open to some question because of the general statements often employed which are not usually included in standards. This, of course, is

*For information and prices on ORSANCO publications, write to the Commission, 414 Walnut St., Cincinnati, Ohio.

the result of insufficient technical data at hand to permit the establishment of standards. It is heartening to note a tendency to use the word "objective" which gives the flexibility necessary for the "most appropriate" use concept and for changing conditions. "Criteria" denote a method of measurement or a means of forming a judgment. It is in this area particularly where the lack of data or the existence of conflicting technical data or both make for difficulty. It is in this area, too, that industry, industrial associations, technical societies and government agencies can develop the necessary knowledge to make for a realistic solution of the industrial waste disposal problem. For this reason and thus reflecting the progressive thinking of past and present AES Executive Boards, the American Electroplaters' Society has made an effort to cooperate with interstate and federal agencies concerned with industrial waste problems.

Were looking for . . .

back issues of

MONTHLY REVIEW, QUARTERLY REVIEW, PLATING, PROCEEDINGS and RESEARCH REPORTS

to complete our file at National Headquarters. Missing are the following copies which we hope generous members will send us:

PROCEEDINGS:—1944, 1939, 1938, 1937, 1934 and all prior to 1928

REVIEWS AND PLATING:—

1910—Jan., Feb., March, April, May, Sept., Oct., Nov.
1911—June, July, Aug., Sept., Oct., Nov., Dec.
1912—Jan., Feb., Sept., Oct., Nov.
1913—March, April, May
1914—March, April, May, Aug., Sept., Oct.
1915—Jan., Feb., March, April, June, July, Aug., Sept., Oct., Dec.
1916—Jan., March, April, May, June, Aug., Oct., Nov.
1917—Jan. through Dec.
1918—Feb., March, May, Sept.
1919—Feb., March, May
1920—Jan., Feb., March, April, July, Aug., Sept.
1921—March, April, May, July, Aug., Nov.
1922—Jan., Feb., May, June
1923—Aug.
1926—July
1927—May, June
1928—Oct.
1929—May
1948—Jan., March
1950—Jan.

RESEARCH REPORTS:—

Serial No. 5, Project 2, "Determination of Impurities in Electroplating Solutions, Parts VII-XIV" by E. J. Serfass and Associates;

Serial No. 7, Project 1, "Stripping of Copper from Various Base Metals, Parts III-V" by F. C. Mathers and E. L. Martin;

Serial No. 8, Project 3, "Adhesion of Electrodeposits, Parts V-VI" by A. L. Ferguson;

Serial No. 10, Project 6, "Porosity of Electrodeposited Metals" by N. Thon and D. Kelemen;

Serial No. 11, Project 7, "Methods for Testing Thickness of Electrodeposits" by H. J. Read and J. H. Thompson;

Serial No. 12, Project No. 9, "Physical Properties of Electrodeposited Metals" by A. Brenner and C. W. Jennings;

Serial No. 13, Project No. 5, "Effect of Impurities and Purification of Electroplating Solutions" by D. T. Ewing, R. Rominski and W. King.

Mail copies to Headquarters. We'll be glad to pay the postage.

AMERICAN ELECTROPLATERS' SOCIETY
445 BROAD STREET, NEWARK 2, N. J.

41ST ANNUAL AES CONVENTION

July 12-15, 1954

Plating Industry in the New York Area

Plans for the forty-first annual convention of the American Electroplaters' Society are going ahead at a rapid pace, and there is every indication that, under the sponsorship of the New York Branch, this year's meeting will be an outstanding affair. The Convention will be held at the Hotel Statler, New York City, July 12–15.

Arrangements are being made for the various branches to exhibit unusual and exceptionally interesting products.

George Cooperman, chairman of the Exhibits Committee, reports that, based on the outstanding response from many of the branches assuring him of their intentions to exhibit plated specimens, this should be the most exceptional exhibit ever displayed at an annual convention. George requests that secretaries who have not replied to his letter regarding the exhibit please do so at their earliest convenience.

G. Cooperman M. Ranno

The New York Branch looks forward to receiving many exhibits from local firms. There are probably more diversified types of electroplating done in the New York area than in any other part of the United States. Such operations as plating of cadmium, nickel, chromium, gold, silver, rhodium are quite common. Plating on plastics, glass, wood, horn and other nonmetallics also is done. Plants doing other types of finishing such as vacuum metalizing and organic types of coatings are quite common. Barrel plating installations are numerous and quite large. Some plants, though quite small, still carry on in color finishing of medallions, bas reliefs, etc. The New York area still boasts of some job shops which do torch coloring, hand relieving of bronzes in greens, blues and the regular bronzing operations. More difficult finishes such as "mother-of-pearl," and other oxidized finishes on silver also are done in New York City.

A plant which has no generator, but since it has direct current, works by means of electric light bulbs to control the current supply in its plating baths. This plant does refinishing of musical instruments and has gained a reputation as one of the best refinishing shops on this type of work in the area.

The largest collective group of job shop owners in the area is the Masters' Electro-Plating Association, Inc. Any type of finishing can be done by at least one member of this group. The MEPA has pledged itself to two tasks: first to furnish their customers with the best quality of work; second, to further the interests of the industry. Officers of the group are Philip Ranno, chairman of the executive committee; Alfred D'Agostino, vice-chairman; Frank Kaiser, treasurer; and Silvio C. Taormina, executive secretary.

Metal Finishing Suppliers' Association

The support of AES activities by the industry's manufacturers and distributors is extensive throughout the whole year, but is especially evident and instrumental in the success of each year's annual convention through the activities of the Metal Finishing Suppliers' Association.

The Association's first activity will be the Annual Fellowship Luncheon and business session on Monday, July 12, the first day of the convention, which is open to supply houses and all representatives catering to the industry.

That evening the MFSA will again sponsor the Fellowship Open-House Party, which is always a high light of the convention.

Joe Duffy, perennial golf tournament chairman, is busy making arrangements for the golf tournament which will be held during the convention.

project no. 12

project director:
HENRY B. LINFORD*

associate:
DAVID O. FEDER*

location:
COLUMBIA UNIVERSITY, NEW YORK CITY

Acknowledgment is due the Research Committee, Dr. D. Price, Oakite Products, Inc., Chairman; The Research Directing Subcommittee, Mr. Walter L. Pinner, Houdaille-Hershey Corp., and Clarence H. Sample, The International Nickel Co., Chairman and Vice-Chairman, respectively; and the Project Committee, Mr. E. T. Candee, Lea Manufacturing Company, Chairman; Dr. Edward Parker, Technic, Inc., and Dr. E. B. Saubestre, Sylvania Electric Products, Inc., for their contributions to this project.

*AUTHORS

CLEANING AND PREPARATION OF METALS FOR ELECTROPLATING

VIII. EFFECT OF OXIDE FILMS. A SURVEY OF THE LITERATURE

SUMMARY

This literature survey summarizes previous work on the effects of electroplating onto oxide soiled basis metals. A working definition of surface cleanliness which is suitable for Project needs is discussed. The methods by which oxide films are formed, and some of their pertinent characteristics, are examined. The mechanism of metal deposition, crystal formation, and adhesion are considered. In the light of these facts, the interfacial phenomena occurring during the plating process onto an oxide-soiled metal surface are interpreted. Finally, the effects of these processes and of the films themselves on the end product, the electroplate, are evaluated.

Object and Scope

The object of this Project is to investigate the cleanliness requirements of metals being prepared for electroplating. The first phase of the work, recently completed,[1] has considered the evaluation of organic contaminants present on metal surfaces prior to plating. The second phase will consider inorganic contaminants, with special reference to oxide films.

This research will attempt to determine:

1. What happens, during the electroplating process, to the oxide film which was initially present on the basis metal.

2. What thickness of this oxide film is necessary to interfere with the plating operation.

3. How oxide film thickness affects the characteristics of the electroplate, such as adhesion and structure.

It is recognized that all these phenomena may depend on the particular system under consideration. Hence, the results may be a function of the structure of the basis metal and its oxide, type of plating bath used, and of the particular metal deposited.

Nature of the Problem

For the purpose of this discussion, a "perfectly clean" metal surface may be said to be one which is uncontaminated by any foreign atoms. If one could assume that there are no metallurgical weaknesses, it is probable that such a "perfectly clean" metal surface would offer the ideal basis for receiving an electroplate. Such a surface would consist of metal atoms with unsatisfied force fields (both valence and Van der Waals) extending outward. Consequently, it would be extremely difficult to maintain a surface in this condition of "perfect cleanliness." The unsatisfied forces would tend immediately to attach themselves to any molecules or atoms which came within their fields of force, and the once "clean" surface would now become filmed over with an adsorbed film of one kind or another.

Practically speaking, therefore, the plater rarely, if ever, is dealing with a "perfectly clean" surface. More likely, he has a surface which is contaminated in one or more ways. These contaminants may be organic, inorganic, or may be due to altered basis metal surface structure. This research is interested only in inorganic contaminants, and in this category in oxide films in particular. It is shown in greater detail, in the section on theory, that these oxide films are present in more or less degree on almost any metal which is to be plated. A "perfectly clean" metal surface, exposed to air at room temperature for just a few moments, will rapidly acquire a so-called "standing" oxide film of about 10–50 Å thickness. Metals exposed to air at higher temperatures will be covered with even thicker oxide films. Since most plating operations are carried out in a normal atmosphere, it can be understood that in spite of pickling operations, which remove oxide films, more or less, any metal which is about to be plated will probably be covered by an oxide film of at least this thickness. This is, of course, the best case encountered in practice. In less ideal situations, considerably heavier oxide films, incompletely removed in pickling operations, may still be present.

The question then becomes "If these oxide films are present on entering the plating bath, where do they go during the plating operation, and what effect do they have on the various properties of the plate, such as adhesion and structure?" It is quite commonly recognized that the presence of oxide films on the basis metal may cause spotty plating or lack of adhesion. In certain cases, such as plating on aluminum or stainless steel, both of which are known to form extremely tenacious, impervious oxide films on contact with air, special plating procedures are required to obtain adhesion of the electroplate. With other metals, the evidence is less clear-cut. In some cases, oxide films will cause lack of adhesion. In other cases seemingly adequate adhesion will be obtained. As will be discussed in a later section, there exists some meager quantitative work on the effect of oxide films on the adhesion of various electroplates. However, nowhere in the literature has there been any systematic attempt to determine the effect of varying known thicknesses of oxide films on the adhesion, or other properties, of the metal subsequently deposited onto these oxide-filmed basis metals. Likewise, there has been no attempt to ascertain what actually occurs in plating onto such a specimen. Whether the oxide film remains under the final electroplate or is removed by some means in the course of the plating operation has frequently been the subject of speculation, but rarely, if ever, the subject of quantitative experimentation.

This, then, is the problem which underlies this particular research. In the following sections the various aspects of the problem are considered in greater detail.

First, this paper discusses a working definition of surface cleanliness which is suitable for Project needs. Then the methods by which oxide films are formed, and some of their pertinent characteristics, are examined. After this, the mechanism of metal deposition, crystal formation and adhesion are considered. In the light of these facts, the interfacial phenomena occurring during the plating process onto an oxide-soiled metal surface are interpreted. Finally, the effects of these processes and of the films themselves on the end product, the electroplate, are evaluated.

Surface Cleanliness

As previously noted, a "perfectly clean" surface is one which is uncontaminated by any foreign atoms. The surface would be composed only of the atoms of the basis substance, and with a metal these atoms would be arranged in a crystal lattice characteristic of the particular metal. Since the surface metal atoms are surrounded on all sides but one by neighboring atoms, this remaining side, or surface, will have certain unique characteristics due to this asymmetry. In particular, the surface atoms will have unsatisfied fields of force extending outward from the metal surface. These forces are in general of two kinds:

(a) Valence forces accounting for the ability of a surface to form chemical bonds, i.e., "chemisorb" with foreign atoms.

(b) Van der Waals forces which enable the surface to adsorb foreign atoms by so-called "physical adsorption."

These forces account for the unique activity of "perfectly clean" surfaces. It is because of these forces that such surfaces will tend to adsorb onto them any foreign atom which comes within their field of operation. It is quite possible to prepare such perfectly clean surfaces by scrupulous care and working in high vacuum. (Although such clean surfaces will tend to adsorb even an inert substance such as argon, such adsorption will be negligible at room temperature. Therefore, these clean surfaces may conveniently be manipulated in such an inert atmosphere.) Nevertheless, due to the extreme activity of these surfaces it is extremely difficult to keep them in this "perfectly clean" state. It may be said then that a "perfectly clean" surface is a rare phenomenon and is seldom encountered in actual practice.

If then, a plater is not dealing with a "perfectly clean" surface, what kind of a surface is it, and how does this lack of complete cleanliness affect his results? In general, the plater has a metal surface which has undergone some type of fabrication, and therefore has on its surface all the impurities which may have been picked up in this treatment. The metal is then subjected to any of various cleaning cycles (consisting usually of abrasion cleaning to remove heavy mill scale, solvent degreasing, alkaline cleaning, and finally a pickling operation) which, depending on their efficiency, remove most of the impurities present on the metal surface. However, impurities may still remain. Lyons[66] has classified these impurities as follows:

1. Substances not chemically associated with the plating metal or the basis metal, i.e., oils, greases, waxes, soaps, drawing, buffing or polishing compounds, etc.

2. Substances derived from the basis metal, i.e., mainly oxides, but also sulfides, carbonates, phosphates, etc., resulting mostly from previous chemical treatment of the basis metal.

3. Substances due to distortion of the basis metal surface from various finishing operations.

If these impurities may be present on the surface of a metal to be plated, what then constitutes a clean surface for the plater? In general, it may be said that any surface which will not interfere with the deposition of a smooth adherent plate constitutes, from the plater's point of view, a clean surface. Thus, successful cleaning usually consists in the substitution of an objectionable surface film by a film more suitable for plating[66]. Therefore, in this sense, cleanliness is strictly a relative term and is specified only by its result.

As will be shown later, any clean metal (except perhaps gold and a few other noble metals) on exposure to air is immediately covered with a thin layer of oxide, several angstroms thick. It is apparent, therefore, that any appreciable time interval between acid pickling and plating will allow an oxide film to form on the basis metal. Hence, a metal rarely enters the plating bath completely free of oxide. Thus, a clean metal, with regard to oxide, is again one which will take a good plate. However, since in so many cases failure of adhesion or poor coverage occurs, for apparently no reason other than the presence of an oxide film, it seems necessary to set more specific cleanliness requirements.

Although it has long been recognized that oxide films present on metals prior to plating may cause poor adhesion or incomplete coverage, little has been done to determine just how much oxide is necessary to produce poor results. At no time has there been any attempt to correlate the behavior of the plate with the thickness of the oxide film itself. It is the objective of this research to try and set cleanliness standards with regard to oxide films. The Project attempts to

determine, from the plater's point of view, how thick an oxide film a basis metal can tolerate before it no longer can be considered "clean." Needless to say, it is recognized that this standard may be a function of the basis metal material, type of bath used, and of the particular metal deposited.

Oxide Film Formation

Before considering in detail the mechanism of plating over an oxide coated specimen, it would seem advisable to discuss briefly the properties of oxide films and the theory of their formation and growth.

The theory of the mechanism of oxidation has been discussed by literally hundreds of authors. Considerable experimental data have been accumulated, and although the exact physical mechanism of oxidation has not been completely clarified, enough of its details are known so that in most cases a reasonably clear explanation of the observed phenomena may be offered. It is not intended here to offer any more than a superficial explanation and description of the phenomena of metal oxidation. Anyone more deeply interested may consult the original references, of which a partial list is included. It is felt that such a minimum description of the observed facts is necessary for an understanding of the problems involved in this research. A more complete analysis, while undoubtedly interesting, would serve only to obscure the basic problem being considered at this time. With this in mind, the following discussion, taken from several articles by Evans[31], one of the leading workers in this field, is offered.

A. *Growth of Oxide Films*

Description of the Process

With the exception of a few noble metals, any oxide-free metallic surface quickly develops a film of oxide when exposed to pure air. The rate of oxidation is usually rapid at the start, but as the oxide film begins to isolate the metal from the air, the rate falls off. At 25° C, in pure dry air, the rate soon becomes so slow as to be negligible before the film is sufficiently thick to be visible. Many workers have followed the growth of these invisible films at ordinary temperatures, using a variety of methods. Some of these methods are mentioned in a later section below.

At higher temperatures, the oxide film attains sufficient thickness, even in pure air, to produce interference colors which are several hundred angstroms thick. However, interference colors may also be produced at room temperature if the air is impure. Thus, copper at 25° F., exposed to air containing a trace of H_2S, will go through the same sequence of interference colors as are produced in pure air at higher temperatures.

Considerably higher temperatures produce much thicker oxide films which often scale off or crack owing to stresses produced in the formation and growth of the oxide films.

Laws of Film Thickening

Quantitative relations between the mean film thickness, y, and the time, t, were developed in 1922 by several workers,[89,100,106] and innumerable others have examined and extended these laws in more recent times.[50,89,100,106]

There are three important laws:

(a) The parabolic law:

$$\frac{dy}{dt} = \frac{k_1}{y} \text{ or } y^2 = K_1 t + K_2$$

where $K_1 = 2k_1$

(b) The rectilinear law:

$$\frac{dy}{dt} = k_2 \text{ or } y = K_3 t + K_4$$

where $K_3 = k_2$

(c) The logarithmic law:

$$\frac{dy}{dt} = k_5 e^{-k_6 y} \text{ or } y = K_5 \log(K_6 t + K_7)$$

where $K_5 = 1/k_6$; $K_6 = k_5 k_6$

At any given temperature, all these k's and K's are constant.

In the absence of complications, the parabolic law is the one most generally obeyed. When the film contains cracks, cavities, or is very thin, one of the other laws is usually followed. In similarity to heat flow, the movement of material through the oxide layer is likely to be inversely proportional to the thickness of that layer. In some cases, film formation may be regarded as consisting of two distinct films: a thin, compact, protective layer next to the metal, covered by a thicker, less compact, broken layer. In this case, a composite law governs the process:

$$\frac{dy}{dt} = k/(k' + k''y)$$

When $k' >> k''y$, the equation reduces to the rectilinear law, while if $k' << k''y$, the parabolic law is arrived at.

The cracking of thicker oxide films may be related to the volume change produced when the metal oxidizes. Except for the very light metals (sodium, magnesium), most metal oxides normally occupy a greater volume than the parent metal. Thus, an oxide forming on a metal surface is usually considered to be in a state of lateral compression. As the thickness increases, these stresses finally become sufficient to cause cracking or flaking of the oxide film, with attendant release of stress. Whether simple cracking occurs, or blistering, or other more complicated types, depends on the relative values of adhesion and cohesion of the particular oxide film involved. Some types of cracking will bring about growth according to the logarithmic law.

Mechanism of Growth

In the absence of complications, growth has been shown to proceed outwards.[86] Outward movement of the metal, as cations, is possible under certain circumstances, while inward movement of oxygen is unlikely unless cracking has occurred.

According to Mott and others,[50] the growth mechanism of oxide films depends to a great extent on the fact that many oxide lattices are imperfect. Many oxides and sulfides have compositions slightly different from their stoichiometrical formulae. Thus, Cu_2O usually contains less copper than would be expected, giving rise to vacant lattice sites in these imperfect films. The presence of cupric ions on some of the lattice sites, instead of the cuprous ions expected, serves to preserve electrical neutrality. With sulfides, many more vacant lattice sites exist. Thus, a mineral with the nominal composition $Fe_{11}S_{12}$ is really FeS, with about 1/12 of the iron sites vacant.

Outward passage of metallic cations becomes possible through such a film possessing vacant lattice sites. One cation can move to a nearby vacant site, leaving in turn a new vacancy into which another cation can move. Also, through these imperfect films electrons can easily pass outwards, possibly by interchange between a cuprous ion and a cupric ion. In any case, it is quite possible to picture cations and electrons moving outwards through a faulty film. Conversely, the filling up of vacant lattice sites by cuprous ions moving outwards may also be regarded as an inward movement of vacant lattice sites. Thus, many authors speak of an outward movement of electrons and an inward movement of "holes." In any event, the continual formation of new oxide film at the outer surface can occur without check as long as sufficient oxygen atoms are adsorbed on the outer surface to react with the electrons to produce the oxygen ions necessary for the oxide structure.

Equations developed by Wagner,[107] expressing the constant k_1 of the parabolic equation in terms of the electric properties of the film, show that a film substance with a high electric resistance is likely to confer good resistance to oxidation, and vice versa. This immediately makes clear the reason for the excellent protection offered by alumina and beryllia films, since both substances possess high electric resistance. This high electric resistance undoubtedly is connected with the fact that, unlike copper, aluminum and beryllium have fixed valences, and hence do not provide any special

mechanism for the outward transport of electrons and cations. Here it must be emphasized that for continued film growth *both* electronic and cationic conductivity are required. Thus, alumina films are protective because of low electronic conductivity. On the other hand, zinc oxide films may be highly protective due to lack of cationic mobility. A zinc oxide film, instead of containing a deficiency of zinc actually contains an excess over the stoichiometric amount. Therefore, it is not likely to have any vacant lattice sites to facilitate cationic transfer.

With sulfides, considerably more lattice vacancies occur. There is therefore much greater facility of cationic transfer. Hence, film growth would be expected to proceed much more rapidly with sulfides than with oxides. Thus, copper forms interference colors in a slightly polluted (with H_2S) atmosphere at room temperature, while elevated temperatures are necessary to produce this thickness with pure dry air. This offers striking confirmation of the theory.

B. *Methods of Evaluating Oxide Films*

Since any results obtained in this research will depend on Project ability to characterize the oxide films of interest, it would seem worthwhile to enumerate the methods which have been used in the past. In the early stages of this Project, a fairly complete list of about one thousand references was compiled on these various methods, and each method was critically examined as to its adaptability to this particular Project. Some of these arguments are discussed in a later report on experimental technique.

Possible methods for determining oxide films are:

1. Contact resistance[34,47,64,82,78,98,105,108]
2. Methods used in adsorption for measuring very thin films:
   (a) Contact potential[2,8,9,10,12,30,41,55,84,85,110]
   (b) Photoelectric effect[4,36,45,93]
   (c) Accommodation coefficient[5,15,19,79]
   (d) Vacuum microbalance[37,94]
3. Electrochemical reduction[13,22,24,75,76]
4. Adhesion and friction methods[11,29,43,69,70]
5. Optical methods—elliptically polarized light[102,112]
6. Electron diffraction[29,33,38,111]
7. Solution potential[40,56-66,77]
8. Wettability methods[1,16,19,20,31,44,90,92,113]

Structure and Adhesion of Electrodeposits

In order to understand the electrochemical processes occurring at an oxide covered cathode, it seems necessary first to examine briefly some of the processes as they occur on perfectly clean cathode surfaces. In this section, the process of nucleation and growth of electrodeposited crystals, and the variables which govern them, are discussed. Following this, the crystal structure of electrodeposits are reviewed, and finally the nature of adhesion of electrodeposits are examined.

A. *Crystal Growth at the Cathode*

Unless otherwise noted, this section is summarized from a review by Finch and his coworkers.[25]

Factors Which Govern the Process

In common with other crystallization processes, the process of metal deposition and growth at cathode surfaces may be said to depend on two fundamental quantities:[91]

1. The rate of nucleation, i.e., the number of crystallization centers created per unit time, per unit volume.

2. The rate of growth. This is a vectorial quantity and may be resolved into components parallel and perpendicular to the electrostatic lines of force. The main growth is usually parallel to these lines of force. These processes, in turn, depend on:

   (a) Rate of arrival of metal ions
   (b) Their mobility on the cathode surface before becoming part of a growing crystal
   (c) The atomic arrangement on the substrate surface on which the ions are adsorbed and discharged
   (d) The concentration of electrostatic field near the projecting parts of the more or less rough cathode surface
   (e) The presence or absence of other ions, molecules or colloidal substances which can be adsorbed or codeposited on the cathode

Of these, (a), (b), and (c) are dependent on the following external conditions of electrodeposition:

   (i) Concentration of various constituents in the bath
   (ii) Bath temperature
   (iii) Current density and current distribution
   (iv) Degree of agitation

For a given current density, increasing the bath temperature, concentration, or agitation will increase the rate of arrival of metal ions at the cathode. A lower temperature or concentration may reduce the metal ion concentration near the cathode to a point where hydrogen deposition becomes possible. This may cause precipitation of basic compounds on the cathode, which will interfere with the mobility of metal ions on the cathode surface (b).

On a rough cathode, the tendency will be for deposition to occur on the peaks, where the electrostatic field is more strongly concentrated. If, however, the metal ion is tightly bound in a complex, these complex ions have a good chance of diffusing past the peaks. Then metal deposition can occur over the whole cathode surface. Likewise, the presence of colloidal substances or of organic addition agents may produce the same effect. This is probably due to their preferential adsorption on the peaks and projections on the cathode surface. This momentarily insulates the projections and allows deposition to occur in the valleys. Thus, a smoothing action is exerted by these substances.

While (a), (b), and (c) are influenced externally, i.e., by the conditions of deposition, (c) and (d) are characteristic of the substrate surface. This surface may be rough or atomically smooth, and may be amorphous, polycrystalline with random or preferred orientation, or may be a single crystal.

Structure of Electrodeposits

In the process of electrodeposition, crystal growth at the cathode passes through 3 stages:

1. The Initial Stage

The initial stage may be divided into 3 parts, depending on the crystal structure of the substrate.

(a) *Single crystal substrates*

Here the influence of the substrate is most pronounced. In most cases where the lattice parameters of the depositing metal and the basis metal do not differ by more than 15 per cent, the deposit will faithfully continue the crystal lattice of the substrate surface. Thus, crystal continuation will not only occur with deposits of the same metal, but even with a metal of different lattice dimensions from the basis metal. This continuation will persist, in general, on single crystal substrates for several thousand angstroms of deposit thickness.

(b) *Random or oriented polycrystalline substrates*

Here continuation may or may not occur, depending on the metals involved. For thin deposits, parallel growth was observed in some cases, but with copper and nickel on [111] gold, some deposit crystals grew in [100] orientation as well as [111] orientation. No general rules can be set forth.

(c) *"Amorphous" Substrates*

Finch and Sun[26] found that deposits of various metals on mechanically polished copper, nickel or gold all showed random polycrystalline structure in thin deposits. As the deposits thickened, they began to show orientation characteristic of the bath conditions.

2. Transition Stage

The orienting influence of the substrate becomes weaker as the deposit thickens, due to various effects (e.g., adsorption or codeposition of hydrogen or foreign ions, inclusions of metal hydroxides, etc.), all of which interfere with regular lattice formation. The stronger the orienting force, the thicker will be the initial stage of substrate-influenced deposit. Thus, a single crystal may exert its influence up to 40,000 Å or more, while a polycrystalline substrate may begin to weaken at 1000-2000 Å, and on an amorphous substrate the deposit may show orientation characteristic of bath conditions almost from the start. In any case, at some point the substrate influence becomes weakened and external conditions (current density, temperature, concentration, etc.) begin to influence the deposit. While these two opposing forces are of about the same order of magnitude, the deposit structure undergoes a transition a few thousand angstroms thick which leads to the final stage.

3. Final Stage

After the transition stage, the deposit enters the final stage in which the structure of the deposit is determined solely by the external conditions of deposition, and is independent of the nature of the substrate. For all the metals studied the results fall into four groups:

(a) Amorphous deposits are formed when the deposited atoms have weak cohesive forces, and the bath conditions lead to an accumulation of adsorbed hydrogen ions or atoms at the cathode.

(b) Deposits are randomly oriented, with metals of higher cohesive forces, when external conditions are such as to cause excessive hydrogen evolution, or an accumulation of adsorbed hydrogen atoms or ions at the cathode surface because of high hydrogen overvoltage.

(c) Deposits are oriented with a less densely packed lattice plane parallel to the substrate surface. Here deposition will take place to a great extent on the projecting parts of the surface. This will occur, in particular, when the mobility of deposited atoms over the cathode surface is low due to low bath temperature or slight hydrogen evolution.

(d) Deposits are oriented with the most densely packed lattice plane parallel to the substrate. Here the tendency is for those crystal nuclei having the most densely packed lattice planes parallel to the substrate to grow sideways more rapidly than the others. This will occur when the bath temperature is high, assuring high mobility of deposited atoms over the cathode surface, and a high rate of diffusion of metal-containing molecules to the cathode regions. Codeposited impurities would inhibit this tendency for sideways growth.

Once this final stage has been entered upon, the orientation produced will persist throughout the remaining thickness of the deposit, provided that the external conditions (current density, etc.) of electrodeposition are not changed. If these are changed, the ratio of rate of nucleation to rate of growth will be altered and a different structure will be obtained.

B. *Adhesion of Electrodeposits*

Since this Project concerns itself to some degree with the effect of oxide surface contaminants on the adhesion of electrodeposits, it is necessary to discuss the nature of adhesion itself. Ferguson and his co-workers[22] have published an excellent bibliography on the nature of adhesion and the methods for determining the adhesion of electrodeposits. Most of the discussion which follows is, therefore, summarized from Ferguson's papers.

The forces involved in the adhesion of an electrodeposited metal to the basis metal are electrical and magnetic in nature, and may be considered similar to the basic bonding forces which bind together all molecules. Hence, the forces involved in adhesion are essentially the same as those involved in cohesion, adsorption, chemical reactions, and in crystal formation. That is, they are all atomic in nature, and are due to interaction of the fields of force which surround the particular atoms involved.

Since the strength of a force increases with decrease in the distance over which it operates, it follows that the rate at which the strength increases with decreasing distance becomes much greater, the shorter the distance. At interatomic distances, this force reaches a very high order of magnitude. Thus, the greatest manifestation of force strength is within the atom (nuclear forces); the next in magnitude is between atoms within molecules (atomic or valence forces); the next between molecules or atoms of the same composition (molecular or cohesive forces); and finally those between molecules of different kinds (adhesive forces).

Since, according to the theory of metals, only atoms are present, all the forces, including those at the surface which cause adhesion, are atomic in nature. If this is true, then the degree of adhesion of a given deposit becomes largely a question of how intimate a contact can be made between the atoms of the basis metal and those of the electrodeposit. Thus, a perfect bond may be obtained when the basis metal is absolutely free of foreign material. In this connection, a weakened or distorted metal surface layer may be considered as a foreign material since it is interposed between the unaltered basis metal and the electroplate and serves to weaken the adhesion.

As the forces involved in adhesion are those operating between the atoms themselves, it is not surprising that the highest type of bond obtainable is usually considered to be that which occurs when the atoms of the deposited metal continue the crystal structure of the basis metal. "A metal-to-metal bond is obtained in which the atomic forces provide the adhesion. Better bond strength cannot be obtained. The interatomic forces determine the strength of any metal, and it is the full operation of these that define the best bond strength that can be obtained in plated metals."[23] In these cases, the adhesion should be of the same order of magnitude as the tensile strength of the metals themselves. The conditions under which crystal continuation will occur have been fully discussed in the previous section.

Plating Onto Soiled Specimens

Now that one has examined the theory of metal oxidation and discussed the way in which an electrodeposit is formed on a clean surface, the following questions may be considered:

1. How does plating proceed on a soiled (oxide) metal surface?

2. What effect does this oxide have on the final plate?

These questions have often been considered in the literature, but in most cases the conclusions have been based on very meager quantitative data.

A. *Mechanism of Plating Onto Soiled Specimens*

An excellent summary of the various possibilities is provided by Lyons[65] who stated that plating does not require a surface which is "perfectly clean." He listed the various types of films which may occur, and considered how plating may proceed in their presence.

Insulating films

These cause nondeposition of metals. The film is so thick that the basis metal is electrically insulated from the bath, and little or no deposition occurs. Heavy, nonconducting scale or oxide, heavy grease, or stop-off lacquers may be included in this class.

Conducting films

These probably cause peeling of the deposit. The film is conducting by virtue of its thinness, structure, or electrical properties, and the electrodeposit is formed on top of the film. The adhesion of the plate then depends on the adhesive and cohesive strength of this film, which is usually low.

Penetrated films

Varying degrees of adhesion are possible. The film may be porous or contain many discontinuities at which points the plate penetrates to the basis metal. The

degree of adhesion depends on the amount of penetration, area of contacts established, and on the soundness of the plate which bridges between these points of penetration. This case is said to cover the majority of plating situations.

Displaced or replaced films

Adhesion is due to cleaning action of the plating bath. The film is more or less completely removed in the plating bath. In some cases, plating may occur through the film such that the film remains intact, but raised from the surface, while the plate is under the film, in contact with the basis metal.

Film not removed or penetrated

The film is not removed or penetrated but may yield a satisfactory basis for an adherent plate. This is rare.

Film formation in the plating bath

A clean metal surface may react with the plating bath to produce a surface film. Such films may yield good or bad adhesion. This case includes galvanic replacement films, adsorbed colloids, etc.

The first case to be considered is that where the plate forms over the oxide film. Here there are two main possibilities:

1. The conductivity of the film is sufficient for electrodeposition to occur directly on the film.

2. Because of low conductivity, electrodeposition occurs first at gaps, pores and discontinuities in the insulating film.

LoPresti,[45] in silver plating over phosphated steel, cited photographic evidence that the phosphate interface may remain under the silver plate. However, his conclusions are subject to criticism since it is practically impossible to distinguish on the photomicrographs between the line said to be a phosphate coat and the line produced at the interface by the metallographic etch. Hothersall[48] remarked that whether deposition takes place on the film itself or in the interstices of the film will depend on the electrical conductivity of the film. Thus, high conductivity oxides should allow metal deposition on the oxide itself, while with low conductivity oxides deposition will begin at the interstices. Deposition of copper from $CuSO_4$ onto stainless steel cathodes showed the deposit first forming only at isolated points, and then spreading out to yield a continuous coating. Gardam[32] also noted that deposition on stainless steel started at a relatively limited number of centers and spreads laterally. Halla and Tompa[42] studied iron plating onto stainless steel cathodes. They found that the iron deposited over the whole cathode surface, but adhered only at damaged portions of the oxide film. Hothersall and Hammond[51] stated that where films were present on the basis metal, deposition started at discontinuities in the film and spread slowly over the whole cathode surface. Meyer[73] noted that films formed by nonuniform action of cleaning and pickling baths will, if nonconductors, produce incomplete coverage by the plate. If sufficiently conducting, the particles will be covered by the deposit which, however, will be poorly adherent. Liger[46] reported that the speed with which an electrodeposit covered a passivated metal placed in a plating bath depended on the porosity and conductivity of the oxide film. Deposition was not immediate, since the film tended to insulate the metal from the bath. However, current passed through fissures and pores in the film. Little by little, the area of the deposit extended, and finally covered the metal, over the oxide film. Shirley,[97] in plating onto stainless steel, found that copper deposition was localized in streaks and small areas. This suggested that initial deposition might occur only where the metallic surface was free of oxide film, or where the film was very thin, and comparatively harmless. Hothersall[49] conducted one of the few quantitative researches on the effects of oxide films on the adhesion of the electrodeposit. He used copper plating onto nickel specimens as a means of evaluating the presence of oxide films formed by the particular treatment being studied. When no oxide film was present, a continuous copper deposit was formed. If an oxide film was present, the deposit formed in isolated spots or patches on the nickel surface. Marie and Thon[67] conducted what is probably the only quantitative research on the subject of plating onto insulated cathodes. They coated copper cathodes with insulating layers of tripalmitin or beeswax at thicknesses of 50 Å and 300Å, and then deposited copper onto these insulated specimens. The mechanism of deposition, the adhesion, and the microstructure were studied.

They found that thin insulating layers are never completely uniform or continuous. In all cases the deposit started at certain distinct points and spread as electrolysis continued. Only when the deposit had reached a certain minimum thickness did it become continuous. This minimum deposit thickness, necessary for continuity, increased as the thickness of the insulating layer increased. Hence, the insulating layer may be considered as nonuniform. At the start, the deposit will form at the most accessible places, i.e., in the discontinuities of the film. The growth of metal crystals will then form metallic bridges joining isolated points, until a continuous deposit is formed. At first, resistance measurements (obtained from the quotient of total cell voltage divided by current passing) tended to support the conclusion that the electrolysis caused a partial destruction of the insulating layer. However, further data indicated that while some destruction might occur, another phenomenon was responsible for the variations in resistance noted during electrolysis. Thus, they considered that metal depositing in the discontinuities of the film and replacing the electrolyte or gas which had been there was mainly responsible for the resistance changes noted. Initially, the electrolyte in the many channels and discontinuities was depleted, causing momentary high resistance at the start. Then, as metal began to fill up these channels, the resistance decreased until all the channels were filled with metal. The resistance then assumed a more or less constant value. This constant final value may be re-established by dissolving the copper deposit with nitric acid and replating. Alternate cycles of copper plating and re-solution in all cases (with the same filmed specimen) re-established the same final value of the resistance. This indicated that film destruction did not play a significant part in the process. (It might be noted at this point that these "resistance" results might be interpreted in a somewhat different manner, although the same conclusion is arrived at in either case. Thus, at the start of electrolysis, the available cathode area is limited to those places where pores and channels in the organic film expose the metal surface. As deposition progresses, this cathode area increases, until finally the entire cathode surface is available for metal deposition. Hence, at the start the current density is very high, causing high polarization [and high voltage]. As the area increases the current density decreases during deposition, until finally the entire surface is covered with metal at which point the area and current density are constant and the polarization decreases, causing the total cell voltage to level off and approach a constant value. It seems more probable that the voltage changes noted should be due to polarization than to IR drop in the pores of the film. However, this does not alter appreciably the mechanism described by the authors in plating onto a filmed cathode.)

The aluminum oxide film has usually been considered as the main obstacle to plating on aluminum. The natural oxide forms very rapidly, is extremely tenacious, a poor electronic conductor, and greatly interferes with the adhesion of any electroplated metal. Therefore, most processes for plating on aluminum have considered it their prime function to remove the oxide film and to keep it off until the plate has formed. However, in the Travers process[101] the aluminum is deliberately anodized; that is, the natural oxide is replaced by a suitable electrolytically formed oxide which, after suitable modification, serves as a base for plating and forms a bond between the aluminum and the plate. After anodizing, the anodized aluminum oxide film is suitably modified by a NaCN dip, which partially dissolves the anodized film. The time of NaCN immersion is said by West[109] to be critical. One wants only to

dissolve enough of the anodic film to produce pores or etching pits in the film. These should be of such a size as to allow adequate anchorage of the deposit, which builds up from the base of the pits. Travers[101] in discussing his method stated that the modifying treatment pierced the oxide film with millions of tiny holes, thus permitting the subsequent nickel plate to anchor itself to the metal below.

Bengston[3] in discussing the mechanism of plating on aluminum by this process said that metal deposition took place initially within the structure of the oxide coating. The aluminum oxide first turned dark in color (possibly due to formation of an oxide of nickel or finely divided metal), but then soon assumed the characteristic color of the deposited metal. Travers[102] stated that the modification process caused the anodized film to become highly activated with oxygen. Then when nickel plating began, the first nickel deposited was black Ni_2O_3, and not metallic nickel. Ferguson[24] stated that during the plating operation the atomic hydrogen set free at the cathode reduced the Al_2O_3, producing a clean and very active aluminum surface on which the plate was formed.

Since most of these authors considered that the deposition took place initially within the pores of the alumina film, it is not surprising to find that they expected the Al_2O_3 to be present, more or less intact, under the final electroplate. Thus, Heussner, in discussing an article by Travers[102] stated that X-ray and metallographic work resulted in the conclusion that there was an oxide film between the aluminum base and the electroplated coating. Travers[101] also described photomicrographs of cross sections at 500X, which he said clearly showed the modified anodic film on aluminum, with the nickel deposit superimposed on the film. In the same paper, Edwards remarked that similar cross sections at 1000X showed a black band said to be the oxide coating, provided that the time of NaCN modification was not too long. In the latter case, all of the oxide appeared to have been completely removed.

More striking than the metallographic evidence are conductivity data. Thus, Bengston[3] showed that the resistance of silver plated aluminum increased as the time of anodizing increased. Likewise, West[103] noted that the Travers process cannot be used when copper or silver deposits are required to improve the electrical properties, since the anodic film acted as an insulator. In this connection, Hogaboom[46] noted that in cadmium plating of copper contacts, where the cadmium was deposited over an invisible oxide film, the resistance was increased 225 times. He cited this as evidence that the oxide film often remains under the electroplate.

Now that the case of a deposit forming over the oxide film has been examined, it is logical next to turn to the instance where a deposit will not form over the oxide film. In this case, it is probable that the film so effectively insulates the cathode that no deposition can occur. Hothersall and Hammond[52] found that the addition of chromic acid to nickel plating baths, in a concentration greater than a certain critical amount, caused the appearance of bare spots on the cathode. As the concentration of chromic acid was increased, the size of the bare spots increased until, above a certain chromic acid concentration, the entire cathode remained free of nickel plate. They also found that dipping the cathode into chromic acid solution followed by nickel plating gave similar results. They assumed that the chromic acid reacts chemically with the cathode metal (copper) to produce a selectively permeable film on the cathode surface which completely prevents nickel deposition. Likewise, Müller and Stein[83] treated one half of a gold sample cathodically in chromic acid solution. Then, plating the whole sample with silver, they found that initially the untreated half was immediately covered with a silver deposit, while the chromic acid treated half remained free of any silver deposit. If plating was continued, silver eventually began to deposit on the treated half, beginning at the edges and finally spreading over the entire surface. However, the deposit on the treated portion was poorly adherent. Metals such as copper, silver, and brass did not require cathodic treatment in chromic acid solution. The act of merely dipping the parts into this solution prior to silver plating caused the above effect.

In the Bullard-Dunn descaling process,[28] oxide coated metal is treated cathodically in a hot acid sulfate bath containing a small amount of tin sulfate. The vigorous hydrogen evolution serves to loosen and remove the scale and, according to the discoverers, only when the metal is bare and clean will the tin deposit onto these cleaned areas. Whether the oxide must be completely removed before tin deposition will occur, or whether a thin oxide film may be present under the tin, apparently was not considered.

In many cases, films are formed on the cathode by chemical interaction with the plating bath. Hothersall and Hammond[52] found that chromic acid, added to the plating bath, reacted with the cathode metal to form a selectively permeable film which prevented nickel deposition. Müller[81] noted the formation of an oriented chromium-chromate film at platinum cathodes in a chromium plating bath. The presence of HSO_4^- ions is said to make possible reduction of this film and allow deposition of chromium to proceed. If no sulfate is present in the chromium bath, this film effectively prevents deposition of chromium. Liebreich[57] discussed the chemical reactions occurring at the cathode. First, the electrolyte may react with the cathode metal when no current flows. Second, during passage of current the *p*H of the solution may increase near the cathode, causing formation of colloidal complexes which migrate to the cathode. Also, increase of hydroxyl ion concentration can produce precipitates of basic salts or hydroxides on the cathode. According to Liebreich, plating invariably proceeds through such a film. Hydrogen evolution may displace the film, exposing base metal which is very active, and reacts at once with more hydroxyl ion to precipitate metal hydroxides. Thus, these hydroxides are continually forming, breaking up, and reforming. However, while in many cases it may be true that hydroxide films are formed, it seems more data are necessary before it could be said categorically that plating *invariably* proceeds through such a film. The *p*H of the bath and cathode film; the solubility of the metal hydroxide; its rates of formation and of diffusion; and finally the intimacy of the contact between the postulated hydroxide film and the cathode surface are all variables which might affect the validity of the above statement.

It is probable in certain cases that films present on the metal prior to plating may be removed by action of the plating bath. This action may be of two main types:

1. Chemical solution of the film in the electrolyte
2. Chemical or electrochemical reduction of the oxide, or mechanical removal by vigorous hydrogen evolution

Piersol[97] remarked that many plating baths, either because of their chemical composition or because of hydrogen liberation, possess sufficient cleaning strength to remove the last traces of foreign matter or oxide film from the surface to be plated. Hothersall,[49] in a comprehensive study of the effect of various pretreatments on the adhesion of nickel to brass, discussed the action of alkaline cyanide cleaning baths containing copper. Such baths are supposed to deposit copper on clean areas, and cleanliness is supposedly indicated by a continuous copper deposit. Actually, small particles can be bridged over by the copper. The method depends on two factors: (1) the complete removal of oxide films in addition to grease—this must occur during the first few moments of deposition, before such films are covered over; (2) production of a coherent deposit of satisfactory mechanical properties. When the solution is operated near the boiling point, adequate removal of grease and oxide is secured.

Although the plating bath may have a solvent action on the oxide film, this is not necessarily so. Thus, Smith and Karle[99] stated that the oxide film is often not removed in the initial plating cycle.

Reduction of the oxide during the plat-

E. C. Holzem, Superintendent, Plating Industries, Inc., St. Paul, Minn.

"We use Wyandotte products 100% for cleaning prior to ELECTROPLATING!"

— Plating Industries, Inc., St. Paul, Minn.

"We are specialists in electroplating," says E. C. Holzem, Superintendent, Plating Industries, Inc., St. Paul, Minn. "We have to use the best materials in order to maintain our consistently high quality and service.

"We use Wyandotte products exclusively for our cleaning prior to electroplating.

"Our experience has been that Wyandotte not only has the highest quality products but works closely with our industry, both on a national basis and in its own research department, to constantly improve cleaning products and procedures."

The Wyandotte cleaning products used by Plating Industries are: F.S.* — a superior heavy-duty, reverse-current electrocleaner for steel; C.S.R.* — a unique reverse-current electrocleaner for removing carbon smut from steel; and B.N. — a superior, versatile electrocleaner for non-ferrous, as well as ferrous metals.

How about *your* business? Do you want research-developed and production-proved products that will improve the quality of your finishes and reduce operation costs? Contact Wyandotte! Mail coupon today for technical folder or for the services of a Wyandotte representative. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Angeles 12, California.*

*REG. U.S. PAT. OFF.

Largest manufacturers of specialized cleaning products for business and industry

Wyandotte CHEMICALS

Helpful service representatives in 138 cities in the United States and Canada

Wyandotte Chemicals Corporation, Dept. 2226
Wyandotte, Michigan

☐ Please send folder entitled "CLEANING prior to ELECTROPLATING"

☐ Have Wyandotte Representative call

Name _____ Title _____

Firm Name _____

City & Zone _____ State _____

ing operation is a factor which must be considered. Although this reduction may be chemical by the action of nascent hydrogen, or electrochemical, Lyons[65] remarked that it is probably impossible to distinguish between the two. Hothersall[48] warned that since oxides usually occupy a greater volume than the metal, their reduction in situ will produce a spongy metal and yield poor adhesion. However, if the oxide is sufficiently thin to allow the reduced metal to be adsorbed on the crystal lattice of the basis metal, the adhesion will be adequate. Liebreich[57] stated that the air-formed oxide film is usually removed in the first period of deposition, before visible evolution of hydrogen occurs. Tronstad,[57] in reply, remarked that on the contrary the air-formed film is hard to remove even in slightly acid electrolytes, probably because hydrogen evolution is not uniform, but occurs only at "active centers." Meyer[72] also noted that passive films are not totally destroyed by electrochemical activation. Finch and Williams,[27] in an X-ray study of the structure of thin electrodeposits on cuprous oxide substrates, obtained results which indicated that the Cu_2O surface may have been reduced to copper during the first stages of deposition. Lewis[58] noted that anodizing a steel surface in chromic acid prior to plating produced good adhesion of the subsequent plate. Since this is a passivating process, he believed that it must produce an oxide film which is reduced during the plating operation. Mathers and Gilbertson[68] found in thick silver plating onto steel that a preliminary silver strike was effective only if the current density was sufficiently great to cause vigorous hydrogen evolution during the strike. Hothersall,[49] in studying oxide forming treatments on nickel, found that if the specimen was allowed to remain in tap water for 90 seconds there was no effect on adhesion. However, 5 minutes in tap water caused a spotty copper deposit (see above). He therefore concluded that any oxide film formed in 90 seconds is easily dispersed or reduced during the first few moments of plating. Gardam[32] developed a method of plating onto stainless steel, which is said to depend on simultaneous removal of oxide film, and deposition of a nickel film. In the process, a high current density is necessary to produce sufficiently vigorous hydrogen evolution to reduce or disperse the oxide film and to deposit the nickel at the necessary rate. Lyons[65] remarked that reduction of oxides seems less likely than their dissolution or physical displacement in the plating bath.

(To be continued)

ANOTHER "BETTER WAY IN PLATING" FROM UDYLITE RESEARCH

CHROME PLATERS

Cut your chromic acid waste up to 70%!
Eliminate many chrome plating problems!

with ZERO-MIST . . .

UDYLITE'S ENTIRELY NEW, CHEMICALLY DIFFERENT, COMPLETELY STABLE ADDITIVE.

ZERO-MIST makes your chrome plating operation more efficient, more economical, with healthier working conditions:

- ZERO-MIST completely eliminates chrome mist and spray!
- ZERO-MIST cuts film drag-out losses by 50% or *more!*
- ZERO-MIST sharply reduces rinsing requirements and rinse contamination.
- ZERO-MIST eliminates blower discharge of corrosive chromic acid spray—no need for water wash systems!
- ZERO-MIST eliminates spray contamination of other solutions!
- ZERO-MIST drastically reduces, often eliminates chrome stains.

The result of years of intensive research, ZERO-MIST will introduce you to new concepts of economy in chrome plating. Entirely new, chemically different, ZERO-MIST is indestructible! After the original charge of ZERO-MIST in the bath, only small weekly maintenance additions are necessary to replace drag-out losses.

No matter what the concentration, temperature or current density of the chromic acid bath, ZERO-MIST remains unaffected. ZERO-MIST will form only a *thin* foam blanket—in fact, *no* blanket is necessary for its efficient operation. Reduced drag-out through low surface tension and elimination of mist and spray can save you up to 70% of your wasted chromic acid and minimize waste disposal problems.

Save time, save money . . . increase production. Call your Udylite representative or write today for more information to: The Udylite Corporation, Detroit 11, Michigan.

PIONEER OF A BETTER WAY IN PLATING

THE Udylite CORPORATION
DETROIT 11, MICHIGAN

Read all about
chem·o·sol
(a plastisol formulation)

FOR MODERN INDUSTRY
— In General
FOR PLATING RACKS
— In Particular

New Bulletin 141 completely describes this amazing new basic material — tells how Chem-O-Sol can solve your plating rack problems.

Complete Facts On

- What is Chem-O-Sol?
- How Chem-O-Sol converts from liquid to solid
- Versatile application methods such as dipping, casting, spreader coating, wiping, pressure forming and spraying
- Typical production problems Chem-O-Sol has solved in many industries

Write TODAY for New Bulletin 141 — No Obligation

Chemical Products CORPORATION
KING PHILIP ROAD • EAST PROVIDENCE, R. I.

USE READER SERVICE CARD; INDICATE A 346.

CUTMASTER

For Long, Cool Runs On Automatic Work

WILLIAMSVILLE BUFF DIVISION EST 1903 A1 ® DANIELSON CONNECTICUT

Let CUTMASTER's perfect balance, and special construction for extra coolness and service slash your automatic buffing costs. We'll rush you the details—write, wire or phone!

WILLIAMSVILLE BUFF DIVISION
The Bullard Clark Company
DANIELSON, CONNECTICUT

Book Review

DR. HAROLD J. READ
Professor of Metallurgy, The Pennsylvania State University

TEMPERATURE MEASUREMENT IN ENGINEERING, VOL. I, by H. Dean Baker, E. A. Ryder and N. H. Baker, 1953, vii + 179 pages. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price, $3.75.

Aside from four introductory chapters, comprising 33 pages, this volume of a two-volume series is concerned wholly with thermoelectric techniques for measuring the internal temperatures of solid bodies. The treatment is largely of a practical nature, very little theory is given and substantially all of the information is presented in nonmathematical form. Emphasis is placed on the specific details and techniques which are applicable to many types of problems within the field specified above. The result is, happily, a unique and useful book.

It is not unusual for books and reviews on temperature measurement to be little other than a compilation (often out-of-date) of material from instrument manufacturers' catalogs, or at the other extreme, an esoteric mathematical discussion of no utility to a man faced with the problem of designing a thermocouple installation. The authors of this book dispose of indicating instruments in four pages. Mathematics are limited to a few simple expressions or formulas necessary for design purposes.

Techniques for testing and calibrating thermocouple wire are given more attention than the calibration of the finished couples. Explicit details for the making of junctions and splices and for insulating these members of the system are unusually well presented.

All the time and effort of carefully making a thermocouple are lost if it is not properly installed in the body whose temperature is to be measured. The authors have devoted a large portion of their book to this important subject, even delving into the techniques and equipment for drilling the deep holes of small diameter which are so often needed for internal temperature measurements.

There is a surprising amount of material on the application of specific special materials, such as protective coatings, refractories and cements, in the installation of thermocouple elements. Recommendations for their use are based upon the personal experiences of the authors.

Measurement of temperature gradients is often a problem whose importance is matched only by its difficulty. An excellent chapter deals explicitly with solutions to the problem.

The book is clearly written, well indexed and each chapter ends with numerous references which are keyed to the text. They are primarily citations to additional material rather than indications of sources from which the text was derived.

USE READER SERVICE CARD; INDICATE A 347.

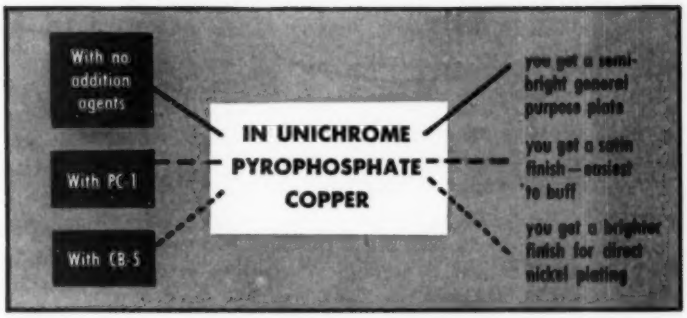
UNICHROME

News about

COATINGS for METALS

Metallic . . . . . Organic . . . . . Decorative . . . . . Protective

Copper Bath Now Gives Three Finishes


With no addition agents
With PC-1
With CB-5
IN UNICHROME PYROPHOSPHATE COPPER
you get a semi-bright general purpose plate
you get a satin finish—easiest to buff
you get a brighter finish for direct nickel plating

New addition agents for Unichrome Pyrophosphate Copper Plating Solution add extra benefits

AMAZING new versatility has been introduced into the Unichrome Pyrophosphate Copper Process by development of two new addition agents. Now, in addition to the time-tested semi-bright deposit, a still brighter or a satin finish can also be obtained. Platers can now choose a deposit that best fits the work to be plated, and thereby cut costs.

BUFFABILITY INCREASED

One of the new addition agents, Unichrome Compound PC-1, increases plating speed as much as 15 to 20%. The satin deposit it produces hides polishing marks on steel. This dense deposit "flows" under the buffing wheel at lighter pressure. Buffing this copper suffices in many cases, eliminating any need to do the harder buffing on subsequent plates.

BUFFING AVOIDED

Unichrome Compound CB-5, the other agent, serves to brighten the deposit. Producing a more uniform plate overall, it can generally eliminate need for copper buffing prior to plating with bright nickel. Even low current density recesses get increased brightness.

Increased plating speed has also been obtained in installations using this addition agent.

MORE COST CUTTING FEATURES

Whether used with either of the new agents, or simply used alone, the Unichrome Pyrophosphate Copper Process offers certain service-proved advantages that reduce plant operating costs.

As a cyanide-free bath, for example, it minimizes cyanide disposal expenses — which include *materials* to treat the wastes; also the cost of waste-treating *equipment*, the *space* it occupies, and the *labor* to operate and maintain it.

Other features insure simplified operation. It maintains its initial wide current density range. It permits simple, more efficient air agitation. It covers well without difficulty, and it is unusually easy to control. Send for new Bulletin CU-3 which gives more details.

HERE'S ECONOMY IN TEMPERATURE-CONTROL COILS

No common plating room acid, except hydrofluoric, can attack tantalum metal. Unichrome Tantalum Coils, therefore, offer a money-saving means for controlling the temperature of acid solutions such as chromium plating baths. A New England company that installed two of them discovered after only one year that the coils had actually paid for themselves by eliminating both the cost of repair or replacement of former type of coils, and the downtime and loss of production normally experienced.

Many chromium plating difficulties eliminated

Case after case has shown that the Unichrome SRHS Chromium Bath virtually obsoletes the ordinary solution. Here are its chief advantages:

Important chemical constituents of the Unichrome SRHS bath are controlled automatically — maintaining the solution at top plating balance. This has slashed control time and maintained plating quality.

Higher plating speeds have been achieved—with plating time often cut 50% or more, and capacity of existing equipment increased.

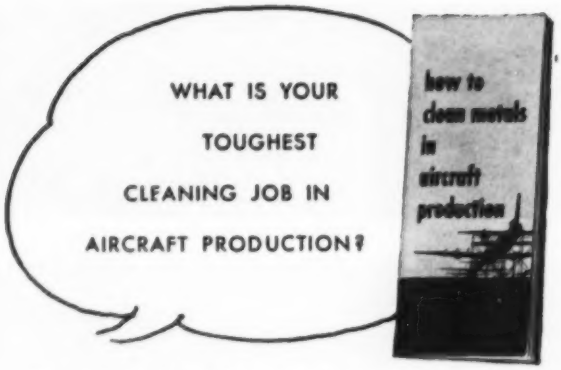
This solution's wider bright plate range has reduced "burning" on edges and "missing" in recesses, thereby further cutting rejects.

In hard chromium operations, its greater leveling action has reduced polishing time. Bulletin SRHS-2 gives more information.

UNITED CHROMIUM, INCORPORATED

100 East 42nd St., New York 17, N. Y.
Detroit 20, Mich. • Waterbury 20, Conn.
Chicago 4, Ill. • Los Angeles 13, Calif.
In Canada:
United Chromium Limited, Toronto, Ont.

FOR FURTHER INFORMATION, USE READER SERVICE CARD: INDICATE A 348.



Does any job in the following list give you trouble? If you'll circle the corresponding number in the coupon, we'll be glad to tell how we can help you.

This list of cleaning (and related) jobs was made up with the advice of several of our customers in aircraft production. It shows, in order of volume, the jobs on which Oakite has most frequently been able to save them time and money. Here it is:

1 Cleaning aluminum, steel and magnesium
2 Stripping paint (solvent or hot tank)
3 Machining, grinding, forming
4 Deoxidizing aluminum
5 Steam cleaning aluminum and steel
6 Deflocculating paint in spray booths
7 Preparing metal for painting
8 Removing scale and corrosion
9 Preventing corrosion

FREE Our 48-page illustrated booklet "*How to Clean Metals in Aircraft Production*" contains information on all the cleaning jobs in the list.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE

Technical Service Representatives in Principal Cities of U. S. and Canada

OAKITE PRODUCTS, INC.
40 Rector St., New York 6, N. Y.

Send me a **FREE** copy of your booklet "*How to Clean Metals in Aircraft Production.*"

I especially wish to get better results in the jobs indicated by the numbers circled below:

1 2 3 4 5 6 7 8 9

NAME_____

COMPANY_____

ADDRESS_____

USE READER SERVICE CARD; INDICATE A 349.

QUESTION BOX

readers' questions of general interest

Q. 172. We plan on using the 33 oz/gal chromic acid with sulfate of 0.33 oz/gal and temperature of 120–130° F for the plating of drills, taps, dies, and small machine parts. Is it possible, under these conditions, to obtain a bright or mirror-bright hard chromium plate of 0.004 to 0.005 inch thickness on a hardened, polished surface using a current density of 2.5 to 3.0 amperes per square inch? Is air agitation desirable for hard chromium plating?

A. It is entirely feasible to expect a bright hard chromium plate over a polished surface under the conditions mentioned. Air agitation is not necessary, but if used the air should be filtered to remove grit, dirt, oils. Many people have had ratio disturbances from the introduction of sulfonated oils into their baths from air compressor lines.

As for bright deposits of hard chromium, every plater engaged in this type of work should regulate cleaning, etching, anode spacing and current density so that every job is fairly uniform, hard and bright.—A. W. Logozzo.

Q. 173. Can you outline methods for reducing the rough deposits from a hard nickel bath?

A. The reasons for rough deposits and porosity are often one and the same, viz., the presence of suspended particles in the solution. It is believed that this is the cause of the difficulties and it is suggested that the bath be filtered continuously at the rate of a full turnover each hour, i.e., 100 gph for a 100 gallon tank. Another factor which must not be overlooked is the replacement of anode bags which are in the least defective. Good plating practice is important, which means that not only particles should be kept out of and removed from the solution, but that impurities also should be kept at a low level. Activated carbon treatment on a continuous basis is useful when the organic addition agent can tolerate this; and low current density electrolysis (AES Proceedings **34**, 228-246 (1947)) will be found to be helpful. It might be added that a highly polished basis metal will tend to produce less porous deposits and that good agitation is helpful in reducing roughness.—D. G. Foulke.

TRICKS OF THE TRADE

The following summary is the first of a series of "tricks" that will be published as a regular feature in this journal. Any readers that have developed a special technique for making a particular job simpler or more efficient are invited to submit their material to any member of the Editorial Board of the magazine or directly to the editorial offices, 445 Broad Street, Newark 2, N.J. An award of $10.00 will be made for each "trick" that is published.

A PLATING TECHNIQUE FOR EXAMINING FINE WIRE CROSS SECTIONS — A. A. WISCO*

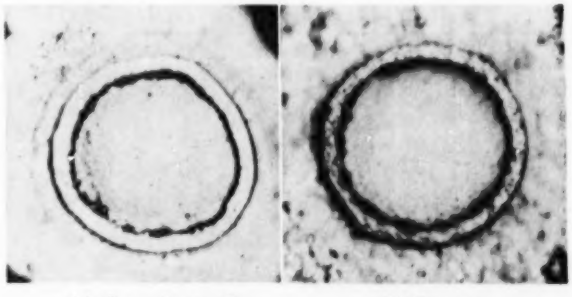
The determination of degree of roundness of fine wire such as nichrome, steel and tungsten presents a problem when the wire diameter is as small as 0.0005 inch. Actually, the human eye is able to determine roundness of specimens when the material in question is studied under a metallographic microscope. However, the mounting of the fine wire in some suitable fashion has always presented difficulties. Normal mounting techniques were found lacking in that consistently reproducible results could not be obtained.

It was found that the study of the cross sections of such fine wire was greatly facilitated by the use of an electroplating step. Plating of the wire gave it mass for easier handling and also provided an area which served to absorb the beveling effects that occur on the outer edges of specimens during preparatory polishing. The cross section of fine wire prepared in this manner was thereby provided with a flat nonbeveled surface.

Detailed plating steps are as follows: the fine wire is mounted by winding several snug fitting turns or loops onto two contacts spaced vertically about 5 inches apart on a small plating rack. The space between each turn or loop is approximately $\frac{1}{4}$ inch. The racked wire is then degreased, electrocleaned cathodically for a few seconds in practically any standard commercial electrocleaner. Care must be taken to assure that the fine wire is completely submerged in the electrocleaner before contact is made with the cathode rod to prevent the wire from burning through because of the high current density. After cleaning the wire is plated with nickel to a thickness of approximately 0.0001 inch. Nichrome wire is plated in the Wood chloride bath, steel and tungsten in a Watts' type solution. Then the wire is copper plated in a rochelle salt-cyanide bath to attain a wire diameter of sufficient size for ease in handling. Deposits of 0.001 to 0.002 inch have been found satisfactory though more or lesser coating thicknesses may work equally as well. The plating provides a stiff wire which, when cut from the rack, can be mounted easily in Lucite, cross-sectioned and polished by standard metallographic practices.

Before samples so prepared are examined, they are etched in an ammoniacal peroxide solution to clean off any copper film which may have been smeared over the wire surface to be studied. (To a solution of concentrated ammonium hydroxide, diluted with an equal part of water, hydrogen peroxide is added on the basis of 10 ml of H_2O_2 per 100 ml of diluted NH_4OH.) Examples of wire prepared by the technique outlined above are shown in the photograph. In the "out-of-round" wire (a) one can see easily that the cross section is not round; the actual difference from maximum diameter to minimum diameter is only 0.0001 inch, but magnification to 1000x reveals this variation very easily. Section (b) represents a round cross section.

The method is useful, not only in the study of wire quality but also in the study of die contour, die wear as affected by varying lubricants, etc. Irregular cross-sectional shapes such as points caused by chipped dies and other die defects can be seen clearly. The steps given above were found extremely useful in studies of certain fine wires. Variations in the plating procedures may have to be employed where the metal of interest may be other than those described.



(a) Out-of-round (b) Round

Cross sections of 0.00125 inch wire.

*Metallurgical Engineer, Westinghouse Electric Corp., Bloomfield, N.J.

BEAM-KNODEL CO.

Distributors for

HANSON-
VAN WINKLE-
MUNNING CO.'S

"PLATEMANSHIP"

A Complete Service

for **Electroplating, Polishing and Buffing, Cleaning and Anodizing**

●

195 LAFAYETTE STREET

CA 6-3956-7 New York 12, N. Y.

USE READER SERVICE CARD; INDICATE A 350.

"THERE'S NO TIME

like the present" to improve your knowledge of modern electroplating techniques. You can gain this knowledge easily and pleasantly through my unique home study course. Once gained you'll profit continuously from it. Write for the facts today. No obligation. Joseph B. Kushner, Electroplating School, 115 Broad St., Stroudsburg 130P, Pa.

USE READER SERVICE CARD; INDICATE A 351.

Article Abstracts

No copies of articles are available at the offices of "Plating". Photostats may be had from libraries having files of the journal in question and offering photostat service, usually at 30-50 cents a page. Ask your public library to consult the Union List for names of libraries having the particular journal. Abbreviations used are those of Chemical Abstracts.

Anodic Behavior of Aluminum and Its Alloys in Sulfuric Acid Electrolytes*. Ralph B. Mason and Phyllis E. Fowle.

This paper deals with the main factors affecting the rate of solution of anodic oxide coatings on aluminum as they are being formed in sulfuric acid electrolytes. Conditions favoring high coating ratios or thick hard abrasion-resistant coatings have been investigated. Low temperatures, high current densities, which permit a shorter time of immersion in the electrolyte, and the addition of substances such as oxalic acid to the electrolyte, favor the formation of such coatings. This has been mainly an investigation of the competition between the rate of formation and the rate of solution of the coatings.

Electrodeposition of Nickel-Molybdenum Alloys from Aqueous Solutions*. D. W. Ernst and M. L. Holt.

Nickel-molybdenum alloys can be electrodeposited from aqueous solutions containing nickel sulfate, sodium molybdate, sodium citrate, and ammonium hydroxide. The effects of *p*H, concentration, temperature, and cathode current density on cathode current efficiency and on the composition of the alloy deposits were studied. A plating solution, containing 0.3 mole/liter of nickel sulfate, 0.2 mole/liter of sodium molybdate, 0.3 mole/liter of sodium citrate, and ammonium hydroxide to *p*H 10–11, showed a current efficiency of

•Presented at the Electrochemical Society meeting at Wrightsville Beach, N. C. (1953).

"IT'S THE FINISH THAT COUNTS"

NEW HOME OF UNITED LABORATORIES COMPANY

OUR NEW PLANT AND EQUIPMENT ENABLES US TO MANUFACTURE TAILORED COMPOUNDS TO YOUR SPECIFIC NEEDS.

IT'S THE FINISH THAT COUNTS
BUFFING COMPOUNDS
UNILAB
BUFFS
PLATING SUPPLIES

GREASELESS COMPOUND

TRIPOLI BAR & LIQUID
STAINLESS STEEL
NU-GLO LIME FINISH
CHROME ROUGE
RED ROUGE—GREEN ROUGE
EMERY PASTE
WHITE ROUGES
ALUMINUM OXIDE PASTE

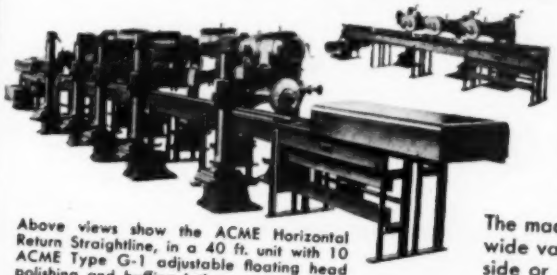
ACME *Automatics* PUT POLISHING *and* BUFFING OPERATIONS *on a low cost production basis . . .*

ACME *Semi-Automatics*

ACME Semi-Automatics are built to "deliver the goods." They can be fully relied upon to cut finishing costs, maintain production levels and stand up under long hours of operation!

The three ACME Semi-Automatics above are from left to right, the ACME A-2, a 2 spindle hand indexing machine for polishing and buffing cylindrical parts up to 12" diameter . . . the ACME L-4, a 4 spindle automatic indexing machine with a normal range of 250 to 400 indexes per hour . . . and the ACME D-10, an oscillating machine for finishing out of round parts. These machines are proved producers.

WRITE FOR CATALOG ILLUSTRATING WIDE RANGE OF TYPES



Above views show the ACME Horizontal Return Straightline, in a 40 ft. unit with 10 ACME Type G-1 adjustable floating head polishing and buffing lathes . . . and a 20 ft. unit with 3 ACME Type G-3 lathes.

ACME *Straight Lines*

ACME Straightlines provide effective solutions to many finishing problems. ACME progressive experience and engineering assure dependable performance at high production levels.

The machine illustrated is unusually versatile and adaptable to a wide variety of work. It may be loaded or unloaded from either side or either end. Polishing and buffing heads may be used on either or both sides and may vary in number to suit the required production and finish.

WRITE FOR OUR STRAIGHTLINE CATALOG ILLUSTRATING OTHER TYPES

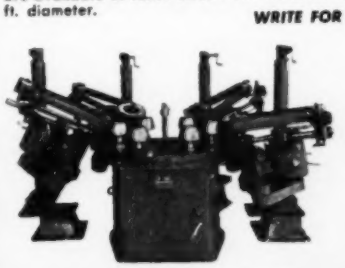
ACME *Rotary Automatics . . .*

ACME 40" Rotary with 6 station indexing table and 4 ACME Type G-1 lathes with belt arm attachment. One second indexing time . . . up to 1800 indexes per hour. Acme Indexing Rotaries are available in table sizes from 18 in. to 10 ft. diameter.

ACME 10 ft. Combination Rotary . . . for continuous operation using 24 continuously revolving spindles or for 12 station indexing operation using every other spindle. One second indexing time . . . up to 1200 indexes per hour.

ACME 50" Continuous Rotary Automatic with 40 spindles equipped with 4 Acme Type G-3 heavy duty 15 H.P. polishing and buffing lathes with inverted spindles. ACME Continuous Rotaries are available with tables up to 24 ft. diameter.

WRITE FOR ROTARY CATALOG



for POLISHING • BUFFING
GRINDING • MICRO-FINISHING
DE-BURRING • WIRE BRUSHING

SPECIAL MACHINERY — AUTOMATIC BUFFING MACHINES

ACME *Manufacturing Co.*

Builders OF AUTOMATIC POLISHING AND BUFFING MACHINES FOR NEARLY HALF A CENTURY

1400 E. 9 MILE RD., DETROIT 20 (Ferndale) MICH.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 353.

Simplify purification of your cyanide zinc plating solution with

McKeon's Zinc-Brite

CUTS DOWN "BRIGHTENER" CONSUMPTION

Wire or phone collect for information

Write TODAY for FREE Test Papers to Assist you in maintaining CLEAN zinc solutions.

Sulphur Products Co. Inc.
228 McKeon Way
Greensburg, Pa.

USE READER SERVICE CARD; INDICATE A 354.

Do you work with ACIDS AND CHEMICALS?

NOW SAVE UP TO 80% on work clothes cost!

WORKLON

•Industrial Apparel of acid and chemical resistant

DuPont ORLON* or Union Carbide DYNEL

★ ACID, CHEMICAL AND ABRASION RESISTANT!

★ U.S. NAVY SAYS, OUTWEARS COTTON 50 TO 1

★ LAUNDERS AND DRIES QUICKLY — NO IRONING!

SAVE MONEY! SEND FOR OUR BIG FREE 1954 CATALOG!

WORKLON, INC. Dept. P3, 253 West 28th St., New York 1
FREE! Rush WORKLON's new, fully illustrated catalog of ORLON, DYNEL, and COTTON WORK CLOTHES.
Firm Name .....
Address .....
City ..... State .....
Attention of ..... Dept. .....

USE READER SERVICE CARD; INDICATE A 355.

Article Abstracts

about 80 per cent when electrolyzed at 10 amp/sq dm. The resulting alloy deposits were bright and adherent, and contained about 20 per cent molybdenum.

Electrodeposition of Cobalt-Molybdenum Alloys from Aqueous Solutions*. R. F. Amlie and M. L. Holt.

Aqueous solutions containing cobalt sulfate, sodium molybdate, and either sodium citrate or malic acid were found suitable for the electrodeposition of cobalt-molybdenum alloys. The effects of *p*H, concentration, temperature, and cathode current density on the current efficiency and on the composition of the alloy deposits were investigated. The Hull cell was used to obtain qualitative information, and regular plating procedures were used for quantitative information. A comparison of similar nickel-molybdenum and cobalt-molybdenum baths also is included.

Periodic Current Reversal in Plating Copper-Lead Alloys*. Nelson W. Hovey, John L. Griffin, and Albertine Krohn.

Apparatus based on the commutator principle was designed and constructed to convert direct current to

*Presented at the Electrochemical Society meeting at Wrightsville Beach, N. C. (1953).

PLATING OR POLISHING PROBLEMS? depend on

the Southwest's leading supplier of industrial plating and polishing

• EQUIPMENT
• MATERIALS
• KNOW-HOW

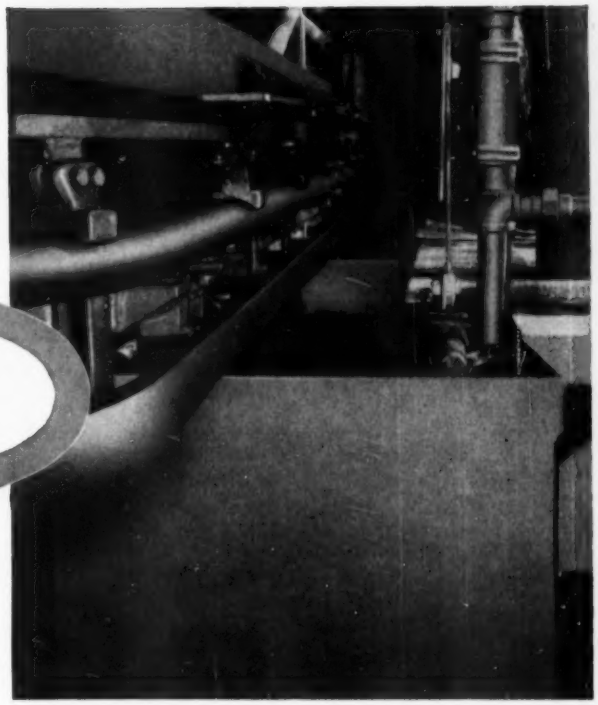
Davies
Supply & Manufacturing Co.

4160 Meramec St. • MOhawk 9332 • ST. LOUIS 16
301 N. Market St. • PRospect 5423 • DALLAS 1

USE READER SERVICE CARD; INDICATE A 356.

DIVERSEY no. 909

DIVERSEY no. 12



Loading end of fully-automatic cadmium line at Miller's Jackson, Michigan plant.

MILLER PLATING CORP.
JACKSON, MICHIGAN *says:*

"No Finer Cleaners are to be Found... Anywhere!"

Diversey is proud of this endorsement from busy, well-known Miller Plating in Jackson, Michigan. Metal cleaning at Miller's is both manual and fully automatic. And to meet Miller's rigid standards, cleaners must be outstanding performers.

SAYS MR. H. E. WELCH, MILLER CORPORATION VICE-PRESIDENT:

"We have used Diversey Products exclusively in soak and electro-cleaning operations prior to all types of decorative and rustproof plating for over three years. We believe no finer cleaners are to be found anywhere!"

HERE'S WHAT DIVERSEY NO. 909 AND NO. 12 OFFER YOU:

No. 909 is a unique, caustic-free, heavy-duty soak tank cleaner for any metal. No. 12 is an electro-cleaner. It's exceptional in that it may be used with either direct or reverse current . . . has a controlled foam blanket to materially reduce the explosive hazard . . . has such high conductivity that you're assured full loading of tanks thereby increasing production and cutting costs. No. 12 is perfect for shops with limited power capacities.

LOOK INTO THESE TWO OUTSTANDING DIVERSEY CLEANERS:

They'll do a better job for you, cut your costs. Write today for additional information, or call your Diversey D-man.

Please send me more information about

☐ Diversey No. 909
☐ Diversey No. 12

NAME_____

FIRM NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

Send to:

THE DIVERSEY CORPORATION
1820 ROSCOE STREET, CHICAGO 13, ILL.
IN CANADA: THE DIVERSEY CORPORATION (CANADA) LTD. PORT CREDIT, ONT.

NICKEL ANODES

FOR SALE

Any type... Any length

GEORGE WOODS
35 WEST 33RD STREET
NEW YORK 1, N Y. BRYANT 9-1220

USE READER SERVICE CARD; INDICATE A 358.

Win the
Germ War!
Use
PIONEER
Stanzoils®
Only a liquid-tight glove gives positive physical protection from chemical *and germ* causes of hand dermatitis.
PIONEER *milled* neoprene stands extra hours of use in contact with oils, acids, caustics, detergents and disinfectants — has higher tensile, greater tear resistance than any other oil-resistant rubber.
Super-Safe grip creates confidence, speeds work — handles wet slippery objects as if dry.
32 PIONEER styles, weights and sizes. Send for Stanzoil catalog — shows quickly how to select best, most economical glove for every job.
NL-34 Duplex, light weight Knit-lined neoprene coated. Curved fingers, Super-Safe grip. Length 10½"
The PIONEER Rubber Company
291 Tiffin Road • Willard, Ohio
STANZOIL
Quality Gloves for 35 Years

USE READER SERVICE CARD; INDICATE A 359.

Article Abstracts

square-wave alternating current, and was applied in electrodepositing copper-lead alloys from a cyanide-tartrate solution. The procedure was successful in eliminating the nodules which occurred in alloy deposits obtained in previous studies using this type of bath.

The Effect of Periodic-Reverse Plating Variables on Density and Electrical Conductivity of Silver*. William H. Colner and Harold L. Schick.

In a study sponsored by Squier Signal Laboratory aimed at improving microwave surfaces, several variables of periodic-reverse plating were investigated as affecting the density and electrical conductivity (and in some cases, smoothness) of electroformed silver specimens.

The following variables were studied: forward current density, reverse current density, forward to reverse time ratio, cycling speed, bath temperature, presence of brighteners, and annealing. Conditions which maximize density and conductivity were found for both periodic-reverse and direct current plates. With periodic-reverse, better properties were obtained.

Recent Developments in the Field of Chromium Plating. Heinz W. Dettner, Metalloberfläche, **5B**, 149 (Oct. 1953).

Reviews literature on modern trends in chromium plating including various fluoride, fluosilicate, fluoborate baths. Included are details on the SRHS type, the Bornhauser sodium tetrachromate ($Na_2O{:}4CrO_3$) bath, the Japanese chromic sulfate-ammonium fluoride bath, the mixed acid (sulfuric and fluosilicic) bath of J. Salauze. Current density-current efficiency curves (2) are shown for the various 250 and 400 g/l CrO_3 solutions. 24 references.—D. G. FOULKE and O. KARDOS.

*Presented at the Electrochemical Society meeting at Wrightsville Beach, N.C. (1953).

FOR SALE

Slightly Used BUFFS

Loose and Sewed
Air-Cooled

Any Quantity

MICHIGAN BUFF CO., INC.
3503 GAYLORD AVE. DETROIT (12), MICHIGAN

USE READER SERVICE CARD; INDICATE A 360.

ALMCO

Supersheen

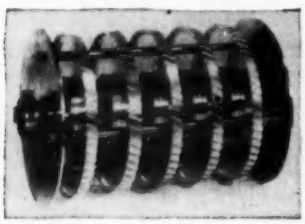
SPEED FINISHING

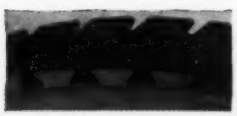
ALBERT LEA MINN

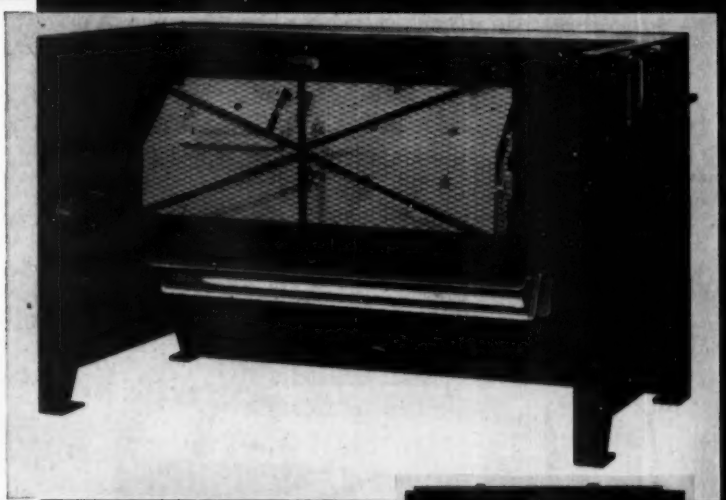
FIXTURE MACHINES FOR SPECIAL FINISHING PROBLEMS

NOW... the tremendous cost savings of Supersheen Speed Finishing available for large, heavy, delicate, or close tolerance parts!

TYPICAL PARTS PROCESSED BY SUPERSHEEN FIXTURE MACHINES







OPENING NEW FINISHING HORIZONS TO AMERICAN INDUSTRY

Supersheen Fixture Processing has greatly expanded the field for modern barrel finishing. Now many parts—formerly impossible to barrel finish—can be Supersheen finished at enormous cost savings. Supersheen Fixture Processing eliminates all former costly hand methods of filing, deburring, etc., thereby making great savings possible.

WHAT IS YOUR PROBLEM? Write us about your specific parts finishing requirements. We'll gladly show you how Supersheen can save you a great deal of money.

Free Catalog

Get the complete money-saving facts. Send the coupon for the new extremely complete 52-page catalog "Supersheen Speed Finishing". See scores of "before and after" pictures of many different parts. Learn the latest on new equipment and compounds. LEARN HOW SUPERSHEEN FIXTURE MACHINES CAN SAVE YOU MONEY.

MAIL COUPON TODAY!

Almco Supersheen, Queen Stove Works, Inc., Dept. C-3
Albert Lea, Minnesota

Gentlemen: Please rush me your new catalog "Supersheen Speed Finishing" and complete details on your Fixture Machines.

Name_____ Title_____

Address_____

City_____ State_____

FILTER 50-1500 GAL/HR ANY ELECTROPLATING SOLUTION

NO ROUGH DEPOSITS
NO PITTING

Service: Filters practically any acid or alkaline solution from pH 0 to pH 14; removes particles down to one micron in size.

Design: FILTER ASSEMBLY fabricated of stainless steel 316, high temperature lucite, rubber-lined, Haveg or Sethrin* resin. FILTER TUBES of cotton, dynel, porous stone, or porous carbon. PUMPS fabricated of Hastelloy, stainless 316, or plastic; centrifugal or self-priming. MOTORS drip-proof, totally enclosed, or explosion-proof, 110 or 220 volt, single or three-phase, 50 or 60 cycle, sleeve or ball bearing. HOSE—special, acid and alkali resistant. BASE—Phenolic laminate on rubber tire ball bearing casters.

Model	Rated Capacity	Overall Size	Weight
LSI-5	50 gal/hr	11" x 14" x 12"	30 lb
LSI-10	100 gal/hr	12" x 16" x 16"	40 lb
ASI-300	300 gal/hr	2' x 2' x 2'	125 lb
ASI-400	400 gal/hr	2' x 2' x 2'	135 lb
ASI-600	600 gal/hr	2' x 2' x 2'	150 lb

Write for Literature

Sethco MFG. CO. 72 Willoughby St., Brooklyn 1, New York

USE READER SERVICE CARD; INDICATE A 362.

Stop

costly shut-downs and heavy repair bills caused by dirt, rust or scale carried in pipe lines to regulators, traps, pumps, meters, burners, etc.

USE Sarco strainers also to remove impurities from any fluid end product.

Sizes ¼" to 8", for any commercial pressure.

Write for new Bulletin 1202 514

SARCO SAVES STEAM — SARCO COMPANY, INC. Empire State Bldg., New York 1, N.Y. SARCO CANADA, LTD., TORONTO 2, ONTARIO

Patent Abstracts

GEORGE B. HOGABOOM

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

No. 2,653,127, September 22, 1953—Method of and Baths for Electrodepositing Cobalt or Cobalt-Molybdenum Alloys—Abner Brenner and Polly S. Burkhead, assignors to United States of America as represented by the Secretary of War.

CLAIM 2. As a bath for the electrolytic deposition of cobalt, a caustic-free, strongly alkaline solution containing approximately 1300 grams per liter of potassium carbonate and a sufficient amount of cobalt chloride which will supply approximately 10 grams per liter of cobalt to said bath.

CLAIM 3. . . . and a sufficient amount of cobalt sulfate which will supply approximately 10 grams per liter of cobalt to said bath.

CLAIM 5. As a bath for electrolytic codeposition of cobalt and molybdenum, a caustic-free, strongly alkaline solution containing approximately 1000 grams per liter of potassium carbonate, a sufficient amount of cobalt chloride which will supply approximately 15 grams per liter of cobalt to said bath and 100 grams per liter of sodium molybdate.

CLAIM 6. . . . a sufficient amount of cobalt sulfate which will supply 15 grams of cobalt to said bath, and 100 grams per liter of sodium molybdate.

NOTE. . . . a current density of 1 to 5 amperes per square decimeter . . . heating said bath to a temperature of 100° C to its boiling point for cobalt. . . . a current density of 1–5 amperes per square decimeter . . . and heating bath to a temperature of 90° C to its boiling point for cobalt-molybdenum bath.

11 claims.

References cited: U. S. Patents 1,344,869; 2,428,404. French Patent 668,800.

HARRISON & COMPANY, INC.

since 4A 1923

Specialists in

BUFFING COMPOUNDS — Cake—Bar, Spray—Dip

CEMENTS for Rolls—Wheels—Belts

BOX 457 HAVERHILL, MASSACHUSETTS

LEA newsreel

ARCH 1954

THE LEA METHOD OF FINISHING

The Lea Manufacturing Company pioneered and continues to specialize in the development of CLEAN-WORKING polishing and buffing compositions. These special methods minimize cleaning by employing selected grades of LEA COMPOUND, LEAROK, or other special compositions which virtually eliminate excessive cleaning or hand-scrubbing common with regular heavy grease compounds.

Here are some typical case studies of Lea Methods.

CASE STUDY #1

Material: Sterling silver.

Article: Table flatware.

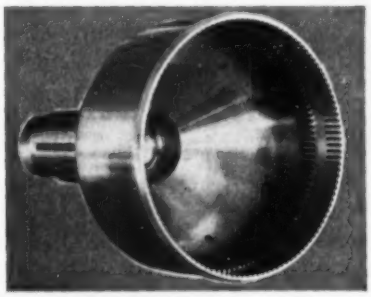
Method of Forming: Customary for this type of work.

Final Finish: Bright Butler.

Lea Method:

1. Cut-down buffing with Tripoli.
2. Cleaning.
3. Lea Compound Grade A-1 or 5023 on a 6" diameter loose muslin buff at 4400 r.p.m.

Remarks: The Lea Method produces a more pleasing finish in about half the time than that produced by any wet method. When a more pronounced Butler finish is desired, a packed buff with Grade A-63 Lea Compound is used.



CASE STUDY #2

Material: Steel.

Article: Bearings, motor parts and other aircraft engine parts, some with counter-sunk holes.

Method of Forming: Forging.

Final Finish: Smooth with burrs removed and slight radius provided.

Lea Method:

Lea Compound Grades "L," "B" or "C" at 5500 surface feet per minute on various types of buffs, string brushes, leather bobs, etc., depending upon the shape of the piece and the accessibility of the surface to be abraded.

Remarks: Work of this type had previously been done by hand with files, emery cloth or burring tools. Lea Compound removes all metal marks and burrs much faster and more economically than hand work. Tolerances are protected by the flexibility of the Lea Compound wheel.

CASE STUDY #3

Material: Brass and bronze.

Article: Bookends and novelties.

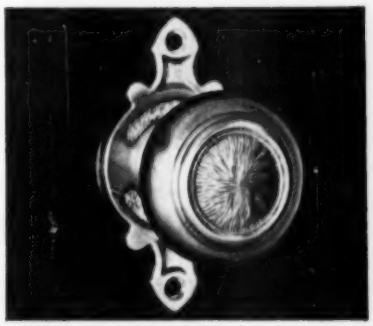
Method of Forming: Casting.

Final Finish: Brushed effect.

Lea Method:

1. Lea Compound Grade "C" on 8" loose wheel at 1500 to 2000 r.p.m.
2. Lacquering.

Remarks: Lea Compound is especially applicable to this type of work as there are numerous recesses in which buffing dirt would lodge with the older method using Tripoli buffing and wet scratch brushing. Accordingly, costly hand cleaning is thereby eliminated.



CASE STUDY #4

Material: Brass.

Article: Door knobs and escutcheon plates.

Method of Forming: Stamping.

Final Finish: Oxidized and relieved.

Lea Method:

1. Cut-down buffing with Tripoli of surface previously polished.
2. Clean.
3. Oxidized in liquid sulphur.
4. Lea Compound Grade "FG" on a 12" diameter loose muslin buff at 1200 r.p.m.
5. Lacquering.

Remarks: Grade "FG" Lea Compound gives a medium butler relieving which requires no cleaning or drying before lacquering.

THE LEA MANUFACTURING CO.
16 CHERRY AVE., WATERBURY 20, CONN.

Lea-Michigan, Inc.
14066 Stansbury Ave., Detroit 27, Mich.

Lea Mfg. Company of Canada, Ltd.
370 Victoria St., Toronto 2, Canada

Lea-Ronal, Inc.
Main Office and Laboratory
42-48 27th St., Long Island City 1, N. Y.
Manufacturing Plant
237 East Aurora St., Waterbury 20, Conn.

LEA GRIPMASTER®
POLISHING WHEEL CEMENT
matching the high quality of other Lea Products, is now obtainable through
LEA-MICHIGAN, INC.
14066 Stansbury Ave., Detroit 27, Mich.

The MASTERS ELECTRO-PLATING ASSOCIATION

INCORPORATED

59 East Fourth Street

New York 3, N. Y.

is proud to announce its 36th Annual Banquet and Entertainment to be held on Saturday, May 8, 1954 in the Starlight Roof at the Waldorf-Astoria, New York City.

Cocktails at 6:30 P. M.

Banquet at 8:30 P. M.

Subscription: $25.00 per person

USE READER SERVICE CARD; INDICATE A 366.

Zialite

Reg. U. S. Pat. Off.

for NICKEL PLATING

The one bath especially designed for plating DIRECTLY on ZINC, LEAD, ALUMINUM, BRASS, COPPER and IRON.

for HARD CHROMIUM

USE Zialite ADDITION AGENTS

Harder deposits. Increased throwing power. Less sensitivity to sulfate content. Exceptionally fine results plating anything calling for Decorative or Hard Chrome.

ZIALITE CORPORATION

92 Grove Street Worcester 5, Mass.

USE READER SERVICE CARD; INDICATE A 367.

Patent Abstracts

No. 2,654,706, October 6, 1953—Electrolytic Regeneration of Spent Caustic—P. J. Gaylor, assignor one-half to Charles W. Ripple.

CLAIM 1. The process of regenerating spent aqueous caustic solution containing oxidizable sulfur-containing impurities which comprises passing a stream of the caustic solution through a diaphragm-type electrolytic cell having insoluble electrodes, impressing on said electrodes a current density of such intensity as to liberate nascent oxygen in direct contact with the oxidizable sulfur-containing impurities in the anolyte and maintaining said solution in the cell, while such electrolysis continues, for a length of time sufficient to bring about oxidization of at least a substantial portion of the sulfur-containing impurities thereof.

12 claims, 5 figures.

References cited: U. S. Patents 1,420,212; 2,140,104. British Patent 800. Electro-organic Chemistry by Brockman (1926), pp. 5–6.

No. 2,654,707, October 6, 1953—Anodizing Rack—D. E. Saffel, assignor to Reynolds Metal Co., Richmond, Va.

CLAIM 1. A plating device for immersing container vessels into an anodizing bath consisting of a frame having a pair of flat parallel spaced-apart vertical metal frame members and a pair of substantially T-shaped inverted apertured end members secured to the tops of said vertical members and further having a pair of spaced-apart rods secured to the ends of the T-shaped end members, a flat longitudinal rack rotatably mounted between the lower ends of the vertical frame members, a plurality of V-shaped vessel holding brackets disposed in open sided slots positioned at one edge of said rack, a longitudinal lock bar having a plurality of apertures therein for removably securing said V-shaped brackets to said rack, a plurality of locked peg-nuts disposed in said apertures of said lock bar for locking said bar to said rack, a longitudinal float

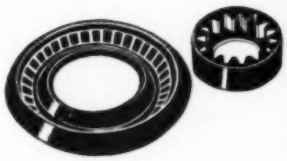
HEY JOE! WHAT COMPOUND AND BUFF DO WE USE ON THIS JOB?
DANGED IF I KNOW.. I'LL CHECK ON IT. SEEMS AS THOUGH ALL I GET DONE IS PAPERWORK ON THESE NEW JOBS!!!
GREASE
TRIPOLI
STAINLESS
LIME
NOW, IF JOE HAD ONE OF THESE HANDY, NEW SCHAFFNER "BUFF 'N POLISH CALCULATORS" HE'D HAVE ALL THE ANSWERS IN A JIFFY! SEND FOR YOURS T'DAY IT'S FREE!
WRITE SCHAFFNER NOW ON YOUR CO. LETTERHEAD.

Write today for free new Catalogue and Samples - Schaffner Mfg. Co., Pittsburgh 2, Pa.

AMAZING TENSILE STRENGTH

PERMANENT FLEXIBILITY

CONTINUOUS ADHESION



RUGGED SCUFF RESISTANCE

POSITIVE INSULATION

DURABLE PROTECTION

When...

THEY'RE MICCROSOL COATED

They Meet the Highest Industrial Standards

MICCROSOL E-1003 Heat-Cured Rack Coating is a 100% solids, non-evaporating material that produces a smooth, tough, leather-like coating which will often outlast the rack. Exceptional adhesion is achieved through the use of our primers.

In addition to the outstanding characteristics listed above, tests for abrasion and resistance to all commonly used plating solutions, acids, and caustics show superior performance in comparison to similar products. MICCROSOL E-1003 has proven to excell as a coating for materials-handling equipment, baskets, hangers, and a wide variety of plating equipment parts.

MICCROSOL E-1003 has an exceptionally high gloss, allowing free drainage, and no solution carry-over.

We will be pleased to help you with your coating problems. Send us full particulars.

MICCRO Products

MICHIGAN CHROME
and Chemical Company

8611 Grinnell Avenue • Detroit 13, Michigan

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 369.

BEFORE PRESSURE-BLASTING

AFTER PRESSURE-BLASTING

SATIN-FINISH, INTRICATE FILIGREE WORK ... NO STOCK REMOVAL, NO ETCHING ... WITH PRESSURE BLAST!

FREE . . . Learn what PRESSURE BLAST can do for you! Die and Mold Polishing, Blending Grind Lines, Deburring, Heat Treat Scale Removal, Honing of Cutting Tools, Pre-plating Cleaning . . . Hundreds of proven, money-saving applications!

Write for our new 8 page fully illustrated Booklet . . . or send samples of work you want tested to:

MODEL A . . . ONE OF 4 STANDARD UNITS. CUSTOM MACHINES DESIGNED TO FIT SPECIAL REQUIREMENTS.

The PRE-PLATE Company, Incorporated
747-1 Windsor Street
Hartford 5, Conn.

USE READER SERVICE CARD; INDICATE A 370.

Check (✓) Seeley Compounds
Bar or Liquid
for
Faster Production—Finer Finishes

—

Burring—Polishing—Buffing Compounds

—

Barrel Finishing Abrasives

—

E. E. SEELEY COMPANY, INC.
Bridgeport 1, Conn.
Since 1919

USE READER SERVICE CARD; INDICATE A 371.

Patent Abstracts

secured to the ends of said rack in spaced relation thereto and a flat metal coil spring of several turns wound axially about one end of said rank and secured at the other end to the flat inner face of one of said flat parallel vertical members for conducting an electrical current from said vertical members to said rack, whereby a plurality of container vessels secured to said racks at their vessel bottoms are gradually uniformly filled with anodizing solution upon lowering said vertical spaced-apart members into said anodizing bath.

1 claim, 5 figures.

References cited: U. S. Patents 1,836,066; 2,362,474.

No. 2,655,471, October 13, 1953—Chromium Plating—Allan E. Chester, assignor to Poor & Company, Chicago, Ill.

CLAIM 9. The method of chromium plating which comprises electrodepositing chromium from a chromic acid plating bath containing in aqueous solution 33 to 52 ounces per gallon of CrO_3, a weight ratio of H_2SO_4:CrO_3 of 1:100 to 1:60 and a quantity of trifluoroacetic acid salt of an oxyalkylated fatty amine which exhibits cationic activity in said solution, said quantity of said trifluoroacetic acid salt being sufficient to retard liberation of chromic acid fumes from said bath.

CLAIM 11. . . . to provide greater throwing power for chromium in said bath.

12 claims.

No references cited.

No. 2,656,283, October 20, 1953—Method of Plating Wire—Albert O. Finch and Alfred E. E. Bishop, assignors to The Commonwealth Engineering Co., Dayton, Ohio.

CLAIM 1. The method of plating metal wire of continuous length which comprises continuously moving the wire therealong from a source of supply through a plurality of chambers including a gaseous metal plating chamber, heating said wire as the same is continuously moved along to a temperature sufficient to decompose a heat-decomposable gaseous metal compound brought in contact therewith, said moving hot wire being maintained in a nonoxidizing atmosphere, moving said heated wire into said plating chamber and subjecting the same to a continuously moving gaseous mass at least a portion of which comprises a heat-decomposable gaseous metal compound, said wire being heated to a temperature sufficient to cause decomposition of said heat-decomposable gaseous metal compound which is circulated in contact therewith and deposition of the metal constituent thereof on the surface of the wire as the same is continuously moved therealong, and maintaining a differential in gaseous pressures between said plating chamber and preceding

MORE ON GETTING **A BETTER START FOR YOUR FINISH**

How Sylvania Electric cut cleaning costs 52.8% with Pennsalt Cleaners

A striking, although not unusual, example of the value of Pennsalt Cleaners comes from the Radio and Television Division of Sylvania Electric Products Inc.

In its Buffalo plant, this Division stamps out thousands of steel radio and TV chassis and other miscellaneous parts every day which are then zinc plated. After a survey of the plant, the local Pennsalt representative suggested that two Pennsalt Cleaners could definitely reduce cleaning costs in the plating operation.

After a test, the Pennsalt cleaners were adopted, and these were the results of the change:

1. Total consumption of cleaners was reduced in each four-week period from 2700 lbs. to 2140 lbs. including make-up schedules.

2. Previous cleaners cost $432.00 a month. The Pennsalt products run $204.78 a month—*a 52.8% saving.*

3. The Pennsalt Cleaners removed stamping oils and shop grime with equal or greater effectiveness than the previous cleaners and were in every other way completely satisfactory.

Here is a brief introduction to the two products that performed this notable cost-cutting feat: the first Pennsalt Cleaner is a concentrated, extra-heavy duty soak or immersion tank alkaline cleaner with exceptional emulsifying powers. The second Pennsalt Cleaner is an alkaline electrolytic cleaner specially compounded for removal of heavy smut deposits when used in reverse cleaning cycle.

The extensive Pennsalt Cleaner line includes products for virtually every type cleaning operation, and Pennsalt specialists have vast experience in properly applying them.

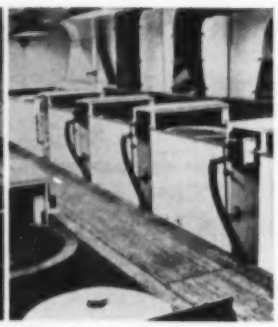
No matter how effective or economical you believe *your* present cleaners to be, there is a very good chance that a saving similar to Sylvania's can be made in your plant with Pennsalt Cleaners! Contact your Pennsalt representative today or write:

PENNSYLVANIA SALT MANUFACTURING COMPANY
Metal Processing Department
396 Widener Bldg., Philadelphia 7, Pa.

Pennsalt Chemicals

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 372.

BEFORE—Stainless steel chemical installation after 14 months' service handling corrosive acids.



AFTER—New unit has plenum chambers, hoods and overhead ducts built entirely of Van Dorn plastics—still resistant to 30 acids after 2 years' service.

Lick Corrosion with

Van-Cor

CHEMICALLY RESISTANT

Non-Plasticized Polyvinyl Chloride

Tensile Strength of Aluminum, with 1/2 its weight • Readily Formed, Machined, Drawn, Molded or "Welded"

For plating and metal finishing, Van-Cor is fabricated into tanks, tank liners, plating racks, ducts, piping, etc. Available forms include: SHEETS—1/32" through 1"; PIPE—1/2" through 6" diameter (10 ft. lengths); ROUND BARS—1/4" through 2" diameter (10 ft. lengths); WELDING ROD—1/8" and 3/16" diameter.

Typical Van-Cor pipes and fittings fabricated to specifications by Van Dorn.

WRITE FOR ILLUSTRATED BULLETIN AND SPECIFICATIONS

INDUSTRIAL DIVISION OF
COLONIAL PLASTICS MFG. CO.

SUBSIDIARY OF
THE VAN DORN IRON WORKS CO.
2685 East 79th Street • Cleveland 4, Ohio

Patent Abstracts

and succeeding chambers, said pressures within the chamber adjacent the plating chamber being slightly higher than within said plating chamber to prevent leakage of said gaseous metal compound from said plating chamber.

No. 2,656,284, October 20, 1953—Method of Plating Rolled Sheet Metal—Harry A. Toulmin, Jr., assignor to The Commonwealth Engineering Company, Dayton, Ohio.

CLAIM 1. A process of continuously plating a moving hot metal sheet as delivered from the mill which comprises the steps of guiding said hot metal sheet therealong while heated to a temperature between 1300° and 1600° F, cooling the same under nonoxidizing atmosphere conditions, said metal being cooled to a temperature which is sufficient to cause decomposition of a heat-decomposable metal vapor compound brought in contact therewith, subjecting said hot moving metal sheet to a plurality of gaseous metal plating treatments, said gaseous metal plating comprising exposing said moving hot metal sheet in a plating chamber to a gaseous mass at least a portion of which consists of a heat-decomposable metal vapor compound, said plating chamber having chambers adjacent thereto which are kept under slightly higher gas pressure than said plating chamber, said sheet being maintained at a temperature sufficient to cause decomposition of said heat-decomposable metal vapor compound and deposition of the metal constituent thereof on said moving hot metal sheet.

No. 2,657,176, October 27, 1953—Electrodeposition of Copper and Copper Alloys Upon Zinc and Zinc Alloys—Hans Berman and Sigmund Katz, assignors to Conmar Products Corporation, Newark, N. J.

The general object of the invention is to produce an article in which the overlying copper or copper alloy plate or deposit is free of "blisters".

The term "blistering" used herein refers to that tendency of the copper or copper alloy plate to lift or peel away from a zinc surface. Blistering has been most evident and troublesome when the copper plated zinc article has had to be subjected to a subsequent heat-treatment, as when the plated article was coated with a thermosetting resin or lacquer which then required baking at elevated temperatures for an extended period of time.

We have found that the tendency of overlying copper or brass deposit to blister is reduced materially by interposing a layer or deposit of zinc which has a lead and cadmium content which is substantially less than the amount of lead and cadmium present in the skin of the zinc die casting. The best results are obtained by plating the zinc alloy die casting from a zinc solution which has been purified so that the resulting zinc plate is substantially free of lead and cadmium.

World's Finest Anode for Chromium Plating

TRAMER

"COPPER CORE" Chromium Anode

"Copper Core" is chemically bonded homogeneously to the lead for its entire length. The entire hook is lead covered for additional protection.

- **This Anode** will conduct 250 amperes based on copper area alone.

Natural flow of current makes entire surface self-cleaning, insuring complete saturation, instant distribution of current, and unusual throwing power. Greatly reduces plating time for a given thickness of deposit.

- **"Copper Core"** distributes current equally throughout the entire length of anode.

The anode is insulated above and below the solution level—which prevents flow of heavy surface currents and burning off at solution line. Conductivity is uniform at all solution levels, regulated only by the cathode depth.

- **"Copper Core"** and point current construction, aids in immediate coverage.

A one-piece copper hook maintains perfect contact —no heating at point of contact, no current failures to solution. "Copper Core" Anodes do not warp out of shape.

The GILBERT TRAMER Co.

POLISHING • PLATING and CHEMICAL • EQUIPMENT

1217 MAIN AVE. CLEVELAND 13, OHIO PRospect 1-2751

Selected territories available for qualified distributors

Patent Abstracts

CLAIM 5. A method for providing a relatively heat-resistant nonblistering deposit containing a substantial amount of copper upon a zinc alloy base, said method comprising plating zinc upon a zinc alloy base from a zinc solution containing not more than approximately 0.0002 ounce of lead and cadmium per gallon of solution and plating a deposit containing a substantial amount of copper upon the zinc deposit.

9 claims.

References cited: U. S. Patents 1,147,718; 1,567,525; 1,601,982; 2,075,623; 2,323,890. German Patent: 501,947. British Patent 482,958. Metal Industry October 22, 1937, pp. 413–414. Transactions Electrochemical Society, "Modern Electroplating" special volume 1942, p. 367. PLATING, February 1948, p. 141.

No. 2,657,177, October 27, 1953—Plating Thickness Regulator—G. H. Rendel, assignor to United States Steel Corporation.

CLAIM 1. Apparatus for controlling the amount of metal electrolytically deposited on an elongated longitudinally moving object comprising a generator for supplying current to said object, a field winding for said generator, means for obtaining a potential proportional to the speed of the object, means for obtaining a potential proportional to the output of said generator, means for comparing said potentials, an electrical connection between each of the first two means and the comparing means, a potentiometer in one of said electric connections, a first contact arm for said potentiometer, means operable by said comparing means for restoring balance between the said potentials, said last named means including a reversible motor, electric means connecting said motor to said comparing means for operation of said motor in opposite directions in accordance with the direction of unbalance of the said potentials, a second potentiometer to a source of d-c power, a third potentiometer connected in parallel with second potentiometer, a contact arm for each of second and third potentiometers, means for connecting said motor to one of said second and third contact arms to move the same proportional to movement of said motor, an exciter for said field winding, electrical means connecting said second and third contact arms to said exciter, and means connecting said motor to first contact arm to move the same proportional to the movement of said motor.

3 claims, 2 figures.

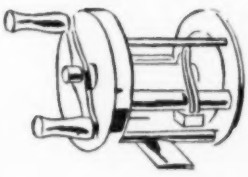
References cited: U. S. Patents 2,325,401; 2,427,661.

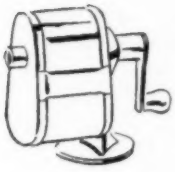
No. 2,658,866, November 10, 1953—Electrodeposition of Tin-Nickel Alloy—Norman Parkinson, Hayes, Eng-

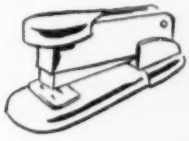
"Why accept imitations when the original costs no more!"
JOE-D Specialists in SISAL BUFFS!
It took specialized "know-how" to conceive and create the first patented Bias Sisal Buff! And that same knowledge has been steadily enlarged and improved by the ablest, most experienced staff in the business—concentrating on this type of buff. Today, our modern, efficient plant proudly produces buffs that meet the most exacting requirements of the metal finishing industry. Always insist on original quality. Specify JOE-D—America's finest Bias Sisal Buffs.
Holders of the original patent on Bias Sisal Buffs—U. S. Pat. No. 2642706
The JOE-D line covers a complete selection of Bias, Bias Spoke (Finger), and Conventional Buffs—as well as quality Polishing Wheels.
ATTENTION: JOBBERS! Some choice territories still available. WRITE TODAY!
the JOE-D Buff Company
SANDWICH, ILLINOIS • TELEPHONE 2171

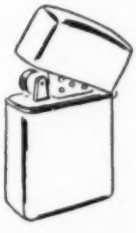
and so to chrome . .

without prior buffing or wiping!









SEYMOUR BRIGHT NICKEL PROCESS

Where specific thicknesses of bright nickel are desired, use Seymour "NC" or "CK" Bright Nickel Processes in a warm plating bath. The warm type brightener solution permits specification barrel nicke plating of any desired deposit from .0002" to .0010", and at a speed four to six times faster than with a cold solution.

Seymour solutions are also available for cold plating baths where a deposit of about .0001" maximum is desired. Both warm and cold type brighteners are simple to maintain and easy to control. Deposits are adherent to properly cleaned base metals, except zinc base direct, and may be chromium plated without prior buffing or wiping. Write for complete information.

Just off the press! A new Technical Data Book on Nickel Silver and Phosphor Bronze. Write for your copy.

DISTRIBUTORS

BART-MESSING CORP.
229 Main St., Belleville 9, N. J.

CROWN RHEOSTAT & SUPPLY CO.
3465 N. Kimball Ave., Chicago, Ill.

EATON CHEMICAL & DYESTUFF CO.
1490 Franklin St., Detroit, Mich.

ENTHONE, INC.
442 Elm St., New Haven, Conn.

W. M. FOTHERINGHAM
977 Niagara St., Buffalo 13, N. Y.

THE GILBERT TRAMER CO.
1217 Main Ave., Cleveland 13, Ohio

MUNNING & MUNNING, INC.
202-208 Emmett Ave., Newark 5, N.J.

SMITH CHEMICAL & SUPPLY CO.
70 Clifford St., Providence 3, R. I.

THE SEYMOUR MANUFACTURING COMPANY, SEYMOUR, CONN.

SEYMOUR

land, assignor to John Ireland, Middlesex, England.

An important feature of the baths used in accordance with the present invention is that they produce satisfactory smooth deposits in the absence of organic addition agents. The tin and nickel cations may be replenished by using anodes of an appropriate tin-nickel alloy. Alternately separate tin anodes and nickel anodes may be used. In the latter case, replenishment may be effected either by passing the total current through each anode successively for an appropriate time or by using tin and nickel anodes simultaneously and apportioning the current through them appropriately.

CLAIM. A process which comprises electrodeposition of tin-nickel alloy coatings from an aqueous solution bath constituted as follows:

	Grams/liter
$SnCl_2 \cdot 2H_2O$	100
$NiCl_2 \cdot 6H_2O$	400
NaF	55
NH_4HF_2	70
Temperature	65° C
Current density	27 amp/sq ft
Coating	Tin 55 per cent Nickel 45 per cent

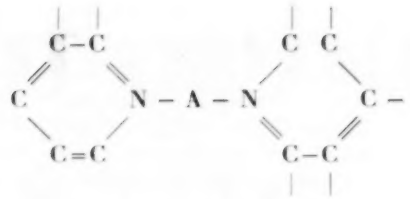
1 claim, 5 examples.

References cited: U. S. Patents Re. 11,624; 1,404,156; 2,085,543; 2,119,304; 2,183,384; 2,381,778.

No. 2,658,867, November 10, 1953—Electrodeposition of Nickel—John D. Little, assignor to The Harshaw Chemical Company.

These deposits, as indicated, have the property of building brightness at a remarkably fast rate so that relatively thin deposits on unbuffed or matte surfaces exhibit extreme brilliance, and they are characterized by excellent smoothing and scratch filling. On the other hand, microscopic examination indicates these deposits are full of hair-line cracks not discernible by the naked eye. Adherence to steel is not good, but a 0.0001 inch to 0.0002 inch copper deposit on steel prior to "quick-bright" nickel provides satisfactory adherence. Adherence to brass copper and gray nickel electrodeposits is satisfactory.

CLAIM 1. A nickel plating solution comprising an aqueous, acid solution of nickel material supplying nickel ions and an addition agent dissolved in said solution and capable of imparting to electrodeposits produced therein improved rates of increasing brightness with respect to increasing thickness of deposit, said solution consisting essentially of a composition from the class consisting of aqueous solutions of nickel sulfate and nickel chloride and said addition agent being at least one bis-pyridinium compound of the formula:



where A is a chain made up of from 1 to 10 carbon atoms and from 0 to 2 oxygen atoms and the free valences are satisfied by hydrogen and from 0 to 4 hydrocarbon groups containing in the aggregate for both pyridinium groups from 1 to 16 carbon atoms, the extra valences of the carbon atoms of A being satisfied by hydrogen and from 0 to 1 hydrocarbon groups containing in the aggregate from 1 to 6 carbon atoms, and where each hydrocarbon substituent group is attached to from 1 to 2 atoms of the group carrying such substituent group, said addition agent being present in solution to the extent of from 0.1 to 1.0 gram per liter.

13 claims, 2 tables, 1 example.

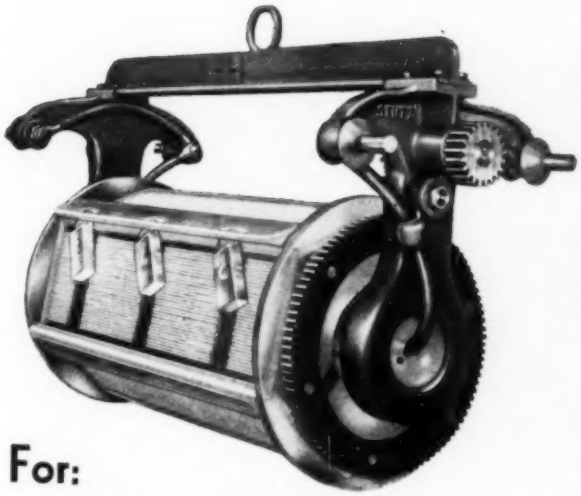
References cited: U. S. Patents 2,513,280; 2,550,449.

No. 2,663,686, December 22, 1953—Production of Electrolytic Chromium from Ferrochrome—R. R. Lloyd, J. B. Rosenbaum and V. E. Homme, assignors to United States of America as represented by the Solicitor of the Department of the Interior.

CLAIM 1. A process for production of electrolytic chromium from ferrochrome comprising leaching said ferrochrome with a hot acidic solution containing chromium depleted liquor from a subsequent stage of the process to form thereby a solution containing chromium sulfate, ammonium sulfate, and iron sulfate, crystallizing the bulk of iron from said solution in the form of ferrous ammonium sulfate, mixing the remaining liquor with an anolyte effluent solution and a catholyte effluent solution containing chromic sulfate, chromous sulfate, ammonium sulfate and sulfuric acid, aging the resulting liquor at a *p*H below 1.2, crystallizing chromium ammonium sulfate from the aged liquor at a temperature higher than that at which said ferrous ammonium sulfate was crystallized, recycling the chromium depleted liquor to provide a substantial portion of the acid solution for leaching said ferrochrome, utilizing the crystallized chromium ammonium sulfate with water to form an electrolyte feed solution, electrolyzing said solution in an electrolytic compartment cell in which chromium is plated from the solution and in which anolyte effluent containing hexavalent chromium ammonium sulfate and sulfuric acid and catholyte effluent containing chromium sulfate, chromous sulfate and ammonium sulfate are produced, reducing the hexavalent chromium of the anolyte effluent to lower valence forms, and recycling said reduced anolyte solution and said catholyte solution for admixture with chrome liquor from which ferrous ammonium sulfate has been removed.

5 claims.

References cited: U. S. Patent 2,507,476.



STUTZ PLATING BARRELS

For:

- Heavy Duty Production
- Highest Possible Current
- Complete Cycle—all solutions (temperature to 185°F)

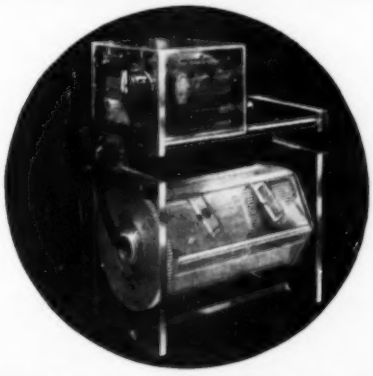
of High Temperature LUCITE

Stutz Plating Barrel Unit for continuous operation through Alkali Cleaning, Acid Pickling, Acid and Alkaline Plating solutions and rinsing. Largest number of cylinder perforations possible.

Stutz Plating Barrel Unit, Motor Drive Mounted Overhead. Continuous rotation of cylinder from one operation to another and where a minimum of solution dragout is important. Roller bearing chain drive to absorb load shock. On a complete Barrel Plating installation, this type of equipment can be made at lower cost since motor drives are not required on each tank station.

Where extremely small openings are required, our patented Dual Hole is used. This design permits solution flow with a minimum of resistance.

WHEN INQUIRING, MENTION PRODUCTION BARREL



Cylinder shaft and bearings by far the largest in the industry . . . means less replacement.

Stutz Deluxe Portable Plating Barrel . . . If your interest is in this small portable unit, please mention this size barrel with your inquiry.

Write for our new Illustrated Literature Showing This and Other Design Arrangements.

"Serving Industry for 33 Years"

GEORGE A. STUTZ Manufacturing Co., 1643 Carroll Avenue, Chicago 12, Illinois

"Complete metal finishing equipment and supplies"

THIRD INTERIM MEETING A SUCCESS

Toronto Branch Praised for Cooperation

Three Nominations Presented for 3rd Vice-President

National Officers Inspect Plating Shop Operations

The footsteps of over 50 delegates, the largest interim meeting attendance, representing 21 branches of the AES, echoed through the lobby and corridors of the Royal York Hotel in Toronto. It was the occasion of the 3rd Interim Meeting of the Society on February 13.

After Dr. Swift's opening remarks AES 1st Vice-President Schaefer presented a nine-month breakdown of the operating budget. He showed that on an overall basis, the Society was in a favorable financial position.

Membership Report

Following Dr. Schaefer's report, 2nd Vice-President Kelly presented a membership report which he supplemented with a written contribution by Stuart Krentel on Los Angeles' activities in this matter, and a call to George Schore for a review of the successful membership methods of the New York Branch.

Branch Officers' Manual

AES 3rd Vice-President Heiman reported on the status of the Branch Officers' Manual—a manual intended to serve as a guide book for branch officers in the discharge of the duties of their offices. Sections of this work were reported on by various committee chairmen.

Following the reports by Dr. Heiman and his group, the delegates heard a talk by Past President F. J. MacStoker on the "Past, Present and Future of the AES." MacStoker's talk concluded the morning session.

Afternoon Session

The afternoon session began with a report by Executive Secretary P. Peter Kovatis in which he cited the need of a sound public relations program. He noted the activity of a group in the Albany-Schenectady area that has signified its intention to petition for a temporary branch charter.

Editorial Board Report

Activities in the publications of the Society were detailed in reports by Editor Korbelak who cited progress in the publications' index and suggested that branches submit one paper per year to resolve the problem of "practical vs long-hair" papers.

Editorial board member Diveley reviewed the results of his questionnaire survey of AES members on their feelings about magazines in the field of electroplating.

Editorial board member Nadel reviewed briefly on the status of Convention papers and closed with a recommendation that Editorial Board activities be given even more publicity than they have been given in the past.

Following the Editorial Board report there was a general discussion, in which most delegates participated, on the paper procurement policies of PLATING.

Broadening of the Society Base

At this time, 2nd Vice-President Kelly submitted a report on his studies into broadening of the base of the AES. His report was supplemented with comments from Delegates Nixon and Geissman, and the reading by Dr. Schaefer of a letter from a member. Then L. Borchert submitted a full report of the AES Research Committee activities, including the latest status of the Process Control Handbook.

Like a postman on his day off . . .

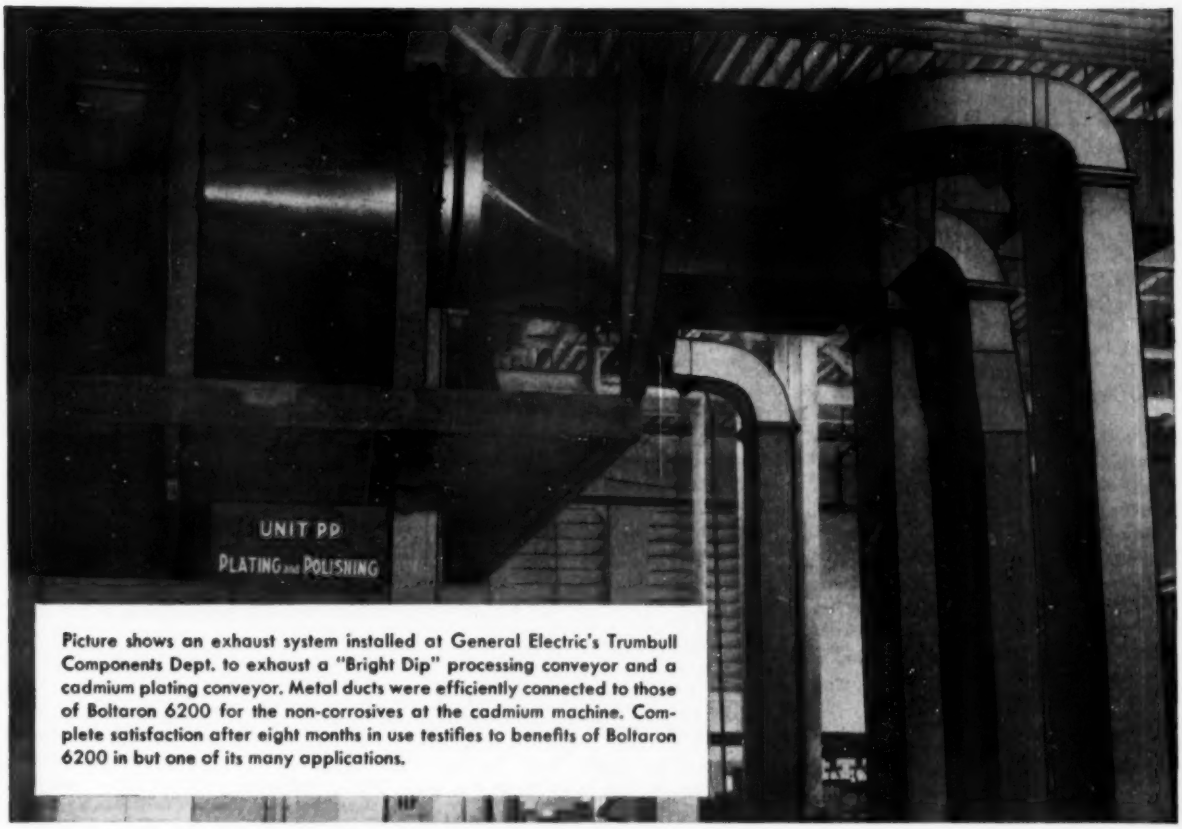
Since Advertising Manager Dietrich was unable to attend because of illness, his report was read by Executive Secretary Kovatis. The report contained statistics on the growth in advertising space and revenue during the past year.

After Delegate Neill presented a report on the Delegates Handbook, expressions of intention to nominate candidates for the office of 3rd Vice-President at the forthcoming New York Convention were presented.

Advancing these notices were Bill Geissman on behalf of Les Diveley, Milwaukee, Ellsworth Candee on behalf of Frank Eddy, Waterbury, and Ed Bruck on behalf of Tom Evans, Indianapolis.

The status of a Convention Manual was noted by Dr. Heiman and future convention reports were given by Schore on New York, Combs on Cleveland and Pierdon on Washington.

Delegate Diggin's resolution on the passing of the Society's first president, George B. Hogaboom, was passed following which the 3rd Interim Meeting adjourned after a resolution of thanks to the Toronto Branch for their "gracious invitation and hospitality."



Picture shows an exhaust system installed at General Electric's Trumbull Components Dept. to exhaust a "Bright Dip" processing conveyor and a cadmium plating conveyor. Metal ducts were efficiently connected to those of Boltaron 6200 for the non-corrosives at the cadmium machine. Complete satisfaction after eight months in use testifies to benefits of Boltaron 6200 in but one of its many applications.

PLANT LAYOUT SUPERVISOR REPORTS COMPLETE SUCCESS WITH *Boltaron* 6200

Unplasticized Polyvinyl Chloride

"A definite answer to replacement and maintenance problems on exhaust ducts and hoods for caustic or corrosive solutions," says Mr. G. R. Buys.

PLAINVILLE, CONN. In an eight-month performance report at the Trumbull Components Department of the General Electric Company here on this new unplasticized polyvinyl chloride, it was revealed that Boltaron 6200 has given "no evidence of breakdown or breakage due to rough treatment, while living up to every expectation." Completely corrosive-resistant and readily adaptable to hundreds of industrial and chemical uses, Boltaron 6200 continues to win wide acceptance and enthusiastic approval in plants across the country.

Boltaron 6200 is manufactured in the United States and is available in the following forms: *sheets* — size 30" x 60" (approximately), in thicknesses from 1/32" to 1"; *rod stock* — (10' lengths) 1/4 to 2"; *pipe* — (10' and 20' lengths) 1/8" to 4"; *fittings* and *valves* — standard, threaded I.P.S. sizes of 1/8", 1/4", 3/8", 1/2", 3/4", 1", 1 1/4", 1 1/2", and 2".

Whether your problem is in electroplating, anodizing or other chemical processing, investigate *first* the many advantages of Boltaron 6200. For more information and laboratory test results, write us direct.

H. N. HARTWELL & SON, INC.

Industrial Plastics Division, Park Square Building, Boston 16, Massachusetts

Licensed fabricators and agents located in Boston, Mass.; Buffalo, N. Y.; Winston-Salem, N. C.; Hawthorne, N. J.; Knoxville, Tenn.; Byesville, Ohio; Owosso, Mich.; Minneapolis, Minn.; Fort Worth, Texas; Los Angeles, Cal.; Seattle, Wash.; Pittsburgh, Pa.; Wilmington, Del.

WRITE TODAY FOR INFORMATION ON NEW, SHOCK-RESISTANT BOLTARON 7200

Branch News

Coming Events

BALTIMORE-WASHINGTON BRANCH

ANNUAL EDUCATIONAL SESSION AND DINNER-DANCE

at 2:00 P.M. and 7:00 P.M. respectively
Saturday, March 13, 1954
Lord Baltimore Hotel, Baltimore, Md.

PAPERS AND SPEAKERS

DR. GEORGE P. SWIFT, AES President, Session Chairman

DR. RICHARD B. SALTONSTALL, Udylite Corp., Detroit, Mich., "Nickel Plating"

HERBERTH HEAD, Briggs Mfg. Co., Detroit, Mich., "Chromium Plating on Stainless Steel"

MYRON B. DIGGIN, Hanson-Van Winkle-Munning Co., Matawan, N. J., "Helpful Hints on Unusual Plating Problems"

LOS ANGELES BRANCH

ANNUAL EDUCATIONAL SESSION AND DINNER-DANCE

at 9:30 A.M. and 7:00 P.M., respectively
Saturday, March 20, 1954
Ambassador Hotel, Los Angeles, Calif.
Good Fellowship Luncheon
12:00 Noon at the Cocoanut Grove

SPEAKERS

DR. HENRY BROWN, Udylite Corp., Detroit, Mich.

ROBERT COUCH, United Chromium Inc., Detroit, Mich.

R. W. MOULTON, Beckman Instruments, Inc., South Pasadena, Calif.

MYRON B. DIGGIN, Hanson-Van Winkle-Munning Co., Matawan, N. J.

Subjects to be announced

CINCINNATI, COLUMBUS, INDIANAPOLIS, LOUISVILLE BRANCHES

SPONSORING THE FIRST ANNUAL TRI-STATE REGIONAL EDUCATIONAL SESSION AND DINNER-DANCE

Saturday, April 3, 1954
at the Hotel Sheraton-Gibson
Cincinnati, Ohio
Educational Session at 2:00 P. M.
Banquet at 7:30 P. M.

PAPERS AND SPEAKERS

DR. G. P. SWIFT, AES President, Session Chairman

A. W. LOGOZZO, President, Nutmeg Chrome Corp., West Hartford, Conn., "Hard Chromium Plating"

J. M. ANDRUS, Chief Chemist, Croname, Inc., Chicago, Ill., "Paint Finishing of Plated Surfaces"

J. G. SEITER, F. J. Stokes Machine Co., Philadelphia, Pa., "Vacuum Metalizing"

BALTIMORE-WASHINGTON BRANCH

The following were elected to membership at the January 12 meeting held at the Hotel Stafford in Baltimore: CHARLES C. BARRETT, Glenn L. Martin Co.; JOHN A. JONES and WILLIAMSON W. MOSS, Almag Chemical Corp.; GEORGE M. BONNETT, Newport News Shipbuilding & Dry Dock Co.; MARGARET A. HILKERT, National Bureau of Standards; and EDWARD J. ROACH, Wyandotte Chemical Co.

The following applications for membership have been approved by the Board of Managers: DANTE G. BERETTA, Penniman & Browne; CHARLES C. SWEGLAR and EDWARD J. WALLACE, Glenn L. Martin Co.

Following the short business meeting, the group listened to an excellent talk on "Radioactive Tracers in Metal Cleaning Research" given by JAMES W. HENSLEY of the Wyandotte Chemical Co.

CARL H. THIEDE, *Secretary*

BRIDGEPORT BRANCH

A regular meeting, attended by 30 members and guests, was held in the Hotel Barnum on January 8 and was presided over by V. CONSALVO.

WILLIAM A. BEIBEL was elected to membership.

HENRY MASKOWSKI reported on the success of the recent Christmas Party held in the Winter Quarters of the Hotel Barnum.

The request of LIBRARIAN R. BONAZZO for permission to schedule a tentative plant visitation in conjunction with a regularly scheduled meeting at Electrolux Corp. on some night other than Friday was acted upon favorably.

Following a motion and an address by FRANK KALAFUS, RAY O'CONNOR was elected an honorary member of the branch. In his acceptance speech, O'Connor expressed his sincere gratitude to the members for being so honored and expressed his desire to fulfill any of the obligations implied.

WILLIAM EHRENCRONA was appointed chairman of the forthcoming Old Timers' Night.

Announcement of the death of GEORGE HOGABOOM was made and was followed by a tribute by Ray O'Connor in the form of a brief review of the personal magnetism of the deceased.

The librarian then introduced GUY CUMMINGS of Frederick B. Stevens Co. Cummings' talk, "Power Supply in the Plating Room," was followed by a question and answer period that resolved some problems existing in the experiences of some of the members. Refreshments were served with WALTER LYNCH of F. B. Stevens Co., as host for the evening.

BOB PARKER, *Secretary-Treasurer*

BUFFALO BRANCH

NATIONAL PAST-PRESIDENT WILLIAM J. NEILL addressed the branch on January 8. His subject was "Copper-Tin Alloy Plating on Castings." Neill discussed plating of three types of copper-tin alloys: 8–10 per cent, 17–21 per cent, and 40–50 per cent. These alloys are plated from a potassium copper cyanide solution containing a complex stannous polyphosphate compound and an addition agent for grain refinement. These alloy plating processes were developed by Battelle Memorial Institute in conjunction with Columbus Metal Products and are known as "Lustralite."

The 8–10 per cent alloy has the appearance of commercial bronze, has much greater resistance to corrosion than the ordinary copper, copper-tin or copper-zinc deposits of equal thickness. It is used for applying an impervious surface to porous castings for use in high (2000 psi) pressure pumps and valves. This alloy also acts as a bearing metal, is wear resistant and is easily machined.

The 17–21 per cent alloy is slightly harder and has greater levelling power than the above.

The 40–50 per cent tin alloy has a color similar to sterling silver, is much harder and more brittle than the other alloys and is deposited in the bright condition. It is used for reflectors as it has a reflectivity only slightly less than silver but more than chromium and is much more tarnish resistant than silver.

ERIC G. SAMPSON, *Secretary*

CLEVELAND BRANCH

The January meeting was held at the Hotel Carter on the 8th with an attendance of 65 members. The speaker of the evening was RAY STANISH, physicist of the Thompson Products Co. His topic was "Atoms in Action," and he presented a highly informative as well as amusing discussion.

At the business meeting, 7 applications for membership were received and accepted. GENE COMBS gave a preliminary report on the 1954 Convention. E. J. ROEHL reported on the work of the Television Committee pertaining to the branch-sponsored show on electroplating over Channel 4–WNBK. JOHN HON-

BRANCH SUBSCRIBERS TO AES RESEARCH FUND

(In addition to per capita tax remittances)

Jackson-Lansing	$100.00
Waterbury	352.14

The above Branches are to be commended for doing something "extra" for AES Research.

NECKER reported for the nominating committee. Refreshments were served through the courtesy of the R. O. Hull Company.

E. J. ROEHL, *Librarian*

COLUMBUS BRANCH

The November 6 meeting was called to order by PRESIDENT EVANS, with 25 members and guests present.

Evans read a letter from the CTC inviting the membership to a dinner at the Seneca Hotel at which JOHN F. VICTOR was to talk.

The secretary read a letter from CLYDE KELLY, Second Vice-President and Membership Chairman of the Society in which he suggested contacting dues-delinquent members in order to help bring them back into good standing.

The April 1954 Regional Meeting at Cincinnati then came under discussion. The 1955 meeting is set tentatively for Columbus. DICK YAGER made and JOHN BEACH seconded a motion to have the branch agree to hold this meeting. After a short discussion with contributions from NATE KOSLIN, BILL NEILL, and DOUG GORDON, the motion passed.

An International Silver Co. movie on sterling silverware manufacture and obtained by FRANK GENTILE, JR., was shown. Coffee and doughnuts were served by MICHAEL FARR.

The speaker, BILL YOUNG, from Wagner Brothers described automatic plating machines.

At the December 4 meeting a letter pertaining to the branch exhibits to be displayed at the next convention was read. JOHN SODERBURG, chairman of the exhibit committee urged an early start.

The following applicants were elected to membership: WILLIAM REID, ROGER P. CASSIDY, North American Aviation; THOMAS F. JACKSON, Kilgane, Inc.; JAMES G. KITCHEN, Belmont Casket Mfg. Co.

The speaker for the evening, W. H. PRINE, International Nickel Co., gave a talk on "Practical Aspects of Nickel Plating."

Refreshments were served by MIKE FARR.

At the January 8 meeting, the speaker, O. B. GORDON of the Behr Manning Corporation, gave an interesting talk on "Polishing with Coated Abrasives."

Refreshments were then served by MIKE FARR.

WM. C. SCHICKNER and JOHN BEACH
Acting Secretaries

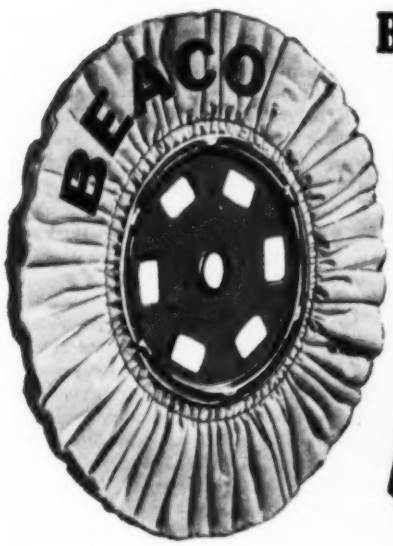
DAYTON BRANCH

A regular meeting was held on January 13 at the Biltmore Hotel with 28 members and guests present.

RICHARD MAEDER, Head of Electroplating in the Process and Material Engineering Dept. of the Frigidaire Div., G.M.C., was unanimously voted an Hon-

Maeder

orary Membership in the Dayton Branch. Dick was graduated from Ohio State University in 1916 and in 1922 became a member of the Dayton Branch. In association with the late WALTER FRAINE, Dick pioneered in the early development of the plating of the common metals as well as precious metals. Dick was one of the first men to put science into the art of plating, and together with the late BOB SUMAN conducted the first platers' school at the Dayton YMCA more than 35 years ago. He was perhaps the first to operate successfully an automatic tin



BETTER BUFFING WITH BEACON

For every buffing need there is no better choice in wheels than *Beaco*. Offering superior performance, *Beaco* buffing wheels have proven themselves in engineering, wear, materials, workmanship and every other *quality that makes the difference.*

The perfect complement to *Beaco* wheels is the Beacon line of buffing compounds—*Vincite, Violet Ray* and conventional—with improved and quicker cutting and coloring for substantially higher production at less cost.

Write today for full information on buffs and compounds, or have our technical staff help you with specific requirements, without obligation.

Beacon plants in the East and Middle West

ESTABLISHED 1888

BEACON SUPPLY CO.

110 Marginal St., Chelsea 50, Mass.

ROTO FINISH

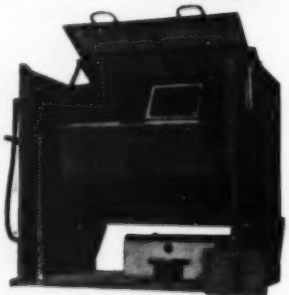
Trademark Reg. U. S. Pat. Office

NOW!

put your precision finishing on a mass production basis

SAVE MANHOURS AND MONEY . . . the original Roto-Finish processes completely eliminate hand finishing in most instances. GET ABSOLUTE UNIFORMITY . . . in any quantity. MAINTAIN exact tolerance on precision parts. CUT FINISHING costs as much as 80% . . . this fact has been proved many times in actual installations. LOWER INITIAL AND MAINTENANCE costs . . . you need only one Roto-Finish machine to replace several manual grinding or polishing machines. No exhaust system is ever required.

DW-60-36-2



DW-45-36-2

ROTO-FINISH COST-FREE ENGINEERING SERVICE GUARANTEES RESULTS!

Send a few unfinished parts to us . . . plus a finished part for a guide, (or we'll be glad to pick them up from your plant) for a "no charge" demonstration. Then sit back and let us *prove* that Roto-Finish will finish your parts . . . to your specifications . . . and save you time and money. We *guarantee* that you can get the same results in your plant that we produce in our laboratory. *There is no obligation for this service.*

Write for fact-packed Roto-Finish Catalog for complete information.

Roto-Finish COMPANY

P.O. Box 987 —

FOREIGN REPRESENTATIVES: CANADA — Windsor — Roto-Finish Canada Limited • ENGLAND — London — Roto-Finish Limited — 39 Park Street — Mayfair • AUSTRALIA — Melbourne — A. Flavell Pty, Ltd. • HOLLAND — Delft — N. V. Roto-Finish Maatschappij — Rotterdamse — WEG 370A • AUSTRIA, GERMANY, SWITZERLAND — Frankfurt a.M. — Metallgesellschaft A.G., Germany • ITALY — Milan — Societa Roto-Finish a R.L. — Sesto S. Giovanni — Viale E. Marelli 31 • FRANCE — Paris — Societe Roto-Finish, 70 rue de la Republique-Puteaux (Seine) • BRAZIL — Rio de Janeiro — Commercial E. Industrial de Formos Werco, Ltds.

plating machine and a continuous anodizing machine on a commercial basis. His informality and humility have endeared him in the hearts of his many friends both locally and nationally. He has always given freely of his knowledge and advice. The Dayton Branch is proud to list Richard Maeder as an Honorary Member.

The membership applications of Robert Wolfe of Springfield Metal Finishing and Bennie Cohen of the Wright-Patterson Air Force Base were approved.

Librarian Holle Luechauer introduced Ezra Blount, editor of Products Finishing who showed a series of color movies depicting life in postwar Japan and then discussed the metal finishing industry in Japan.

Following adjournment, refreshments were served, courtesy of Gordon Lyons and the Hanson-Van Winkle-Munning Co.

John K. Easton, *Secretary*

DETROIT BRANCH

The joint meeting of the branch and the Detroit Section of the Electrochemical Society was held on January 8 at the Hotel Statler. President L. C. Borchert opened the meeting at 8:30 P. M. with approximately 155 members and guests present.

The announcement was made of the death of Founder Member George Hogaboom.

Fifteen applicants were elected to Society membership. This brings the total membership of the branch above the 545 mark.

It was further announced that Midwest Chrome, Solventol Chemical and the C. D. Sparling Co. have joined as sustaining members of the AES Research Program.

Program Chairman Fred Olmstead then presented a movie, "Good Fishing in South America," after which the guest speaker of the evening, Robert J. McKay, International Nickel Company, was introduced. His subject was "Corrosion of Nickel Plate by Oxygen Electrolyte Cells." In his talk, McKay discussed the history of the development of the oxygen cell, demonstrated slides showing the effect of oxygen electrolyte cells on various metals, discussed the setting up of apparatus and functioning of such, and described the effect on nickel-plated steel. It was further mentioned that the oxygen electrolyte cell and the galvanic cell are much the same and reactions are almost identical. All of his points indicated that much work is currently being carried on in determining the reasons of corrosion.

John C. Drinkwater,
Publicity Chairman

HARTFORD BRANCH

A regular meeting was held at the Bond Hotel on January 18 with 55 members and guests present. Preceding the meeting a movie taken at the Weirton

RESEARCH

MORE FACTS—ABOUT THE AES RESEARCH PROGRAM

Research For A Prosperous Tomorrow

"Despite predictions of economic trends, it is agreed that product improvement and development is necessary if a manufacturer wants to remain in business. So too, in Electroplating —new materials, techniques and methods are mandatory to assure our growth and prosperity.

More money is needed now to expand our research and hasten the developments which are needed.

Support AES Research—Invest Now in Your Future

For particulars on how your firm can support this industry-wide program, write Executive Secretary, AES, 445 Broad Street, Newark 2, N. J.

• • •

INVEST NOW!!!

"YOUR BEST BET'S THE AES RESEARCH PROGRAM"

Branch News

Steel Co. by ART LOGOZZO was shown which furnished a picture of Weirton's huge tin plating plant. Following this, LOGOZZO eulogized our beloved Honorary member, GEORGE HOGABOOM, who had passed away on December 31.

The guest speaker for the evening was WILLIAM MURRAY of Enthone, Inc., whose subject was "Adhesion of Electrodeposits and New Methods of Cleaning and Oxide Removal." Briefly he pointed out various materials which when present on the metal affect adhesion. Many slides were shown indicating how adhesion depends on the surface condition of the metal and how this surface condition influences the structure of the deposited metal.

Alkaline derusting and descaling were described and the process was demonstrated with a portable apparatus.

The technical chairman for the evening was GENE DOWLING.

STANLEY PLATOZ, *Secretary*

INDIANAPOLIS BRANCH

FIRST VICE-PRESIDENT ELMER LUNDBERG presided at the December 2 meeting at Fox Steak House, with 35 members and guests present for the dinner and 6 others for the meeting and program.

Evans

The branch proposes to nominate one of its Past Presidents, TOM EVANS, for the office of 3rd Vice-President of the AES at the National Convention at New York City.

Evans, 51, has been in the plating business for 26 years. During the past 14 years, he has owned and operated "Plating Service" at Columbus, Ind., which specializes in hard chromium.

Tom is a large man and, as all large men, he has a friendly and jovial personality. He makes friends easily and is quite capable of administrating the affairs of the AES. Being in business for himself, Tom will be at liberty to travel in the interest of the AES as the needs require.

After some routine business LIBRARIAN BENDER introduced the speaker of the evening who was DR. HAROLD WEISNER of Bendix Corporation, South Bend. His subject was "Tobacco Rhodium" or "Don't Spit in the Plating Tank," which proved to be a very enlightening subject on the plating of rhodium.

The talk proved very interesting and afterwards we found that Dr. Weisner gave the above title to his talk because rhodium plating solutions are very susceptible to any foreign matter.

EDNA ROHRABAUGH, *Secretary*

INDIANAPOLIS BRANCH

The visit of CLYDE KELLY, 2nd Vice-President of the Supreme Society, resulted in a most favorable meeting on January 6 for the 39 members and guests in attendance.

ROBERT VANHOUTEN, general chairman of the dinner-dance, announced that May 15 will be the date of the annual affair at the Indianapolis Athletic Club.

HERB KENNEDY reported on the progress of the regional meeting of April 3 at Cincinnati. There will be plant visitations in the morning, an educational session in the afternoon and banquet and dance in the evening. Two new members were voted into the Society: IRA WILLIAMSON, JR. and JERRE HILLOCK, JR.

AL KRIESE moved and ED BRUCK seconded a motion to make RICHARD T. HENNESSEY an honorary member of the AES. The motion was passed and the president appointed the above two members to draft a story for presentation at the 1954 Convention.

ED BRUCK, EDNA ROHRABAUGH and TOM EVANS were elected as delegates to the 1954 convention in New York. Alternates elected were JOHN HOLLAND, JOHN HOOD and ABRAHAM MAX.

For the next hour the group was privileged to hear about the AES, what it is, how it works and who some of the leaders are.

Other subjects discussed were PLATING and the Research program.

Mr. Kelly told us about EXECUTIVE SECRETARY PETER KOVATIS, and his untiring efforts to get the job well done.

The question of "What is good for your Branch?" was asked by Mr. Kelly. First, publicity is important. This should include social publicity, news of meetings and elections. Next, getting into national affairs, attending other meetings and putting up a candidate for a national office. He praised us for putting up our own Tom Evans for 3rd vice-president for the forthcoming convention.

How can we stimulate interest in our own meetings? This can be done by having a question box so anyone can submit a problem on plating. Another type program can be one where at each meeting a member talks ten minutes on a favorite plating subject.

EDNA ROHRABAUGH, *Secretary*

JACKSON-LANSING BRANCH

A meeting was held December 8 at the Hotel Porter, Lansing, Mich.

An outstanding meeting was held after an excellent roast beef dinner. We were very fortunate in obtaining for the evening, JACK VAN COEVERING, Wildlife Editor for the Detroit Free Press. Van Coevering has travelled extensively over the entire United States, and is a prominent authority on Michigan wildlife conditions.

A mighty interesting talk was given, followed by a color movie covering both sports and hunting winter scenes. Also shown were many striking scenes of spring, summer, and fall activities. Crow shots were of interest along with bow and arrow action and excellent showings of champion dogs.

A short business meeting followed the program.

R. W. REDMOND, *Publicity*

JACKSON-LANSING BRANCH

A regular meeting was held at the Meadow Lark Inn, Jackson, Mich., for another interesting and instructive occasion.

After a soul satisfying dinner of steak with trimmings, DR. B. F. LEWIS, Northwest Chemical Co., spoke on cleaning problems with varying electroplating and other finishes.

A meeting of the Board of Directors followed.

R. W. REDMOND, *Publicity*

LANCASTER BRANCH

A regular meeting was held December 11 at the Mt. Joy Legion with 20 members and guests present.

One person was elected to membership and another application was presented to the branch.

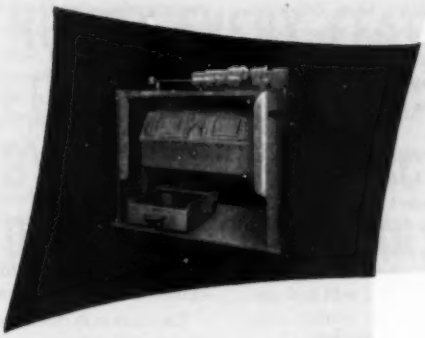
LIBRARIAN GEORGE WELLS introduced the speaker, G. R. SOMERVILLE, Technical Service Representative, Shell Chemical Corporation. He presented a history and development of Epon Resins, and discussed the compounds and different types of each compound that are used. After a very thorough discussion on the subject, he displayed a large variety of articles in which some form of Epon resin had been used; steam pipes coated for corrosion resistance, aluminum foil coated for extra strength and resistance to chemical action, bottle caps, etc.

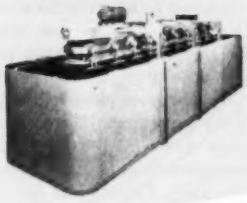
It was apparent from the type and number of questions that were presented to the speaker that many of those present were thinking of applications that might be used in their own fields.

H. A. SAYLOR, *Secretary*

LOS ANGELES BRANCH

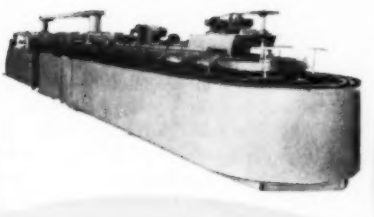
Prior to the regular meeting a committee meeting was held, headed by CHAIRMAN WILLIAM NAIRNE. Its purpose was to get plans under way for the annual educational session and dinner-dance to be held at the Ambassador Hotel, Wilshire Blvd., March 20, 1954.

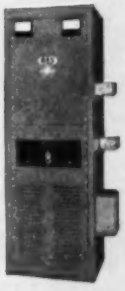


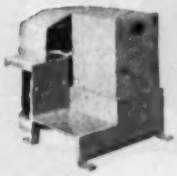


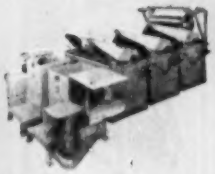
CROWN equipment

- Automatic Machines for Plating-Anodizing, etc.
- Dryers, Centrifugal
- Partially Automatic Plating Machines
- Plating Barrels
- Rectifiers
- Rheostats, Switches — Controls
- Tray — Transfer Type Cleaning — Rinsing — Dipping Units
- Tumbling Barrels — "Horizontal" — "Tilting"
- Special equipment designed and built









COMPLETE DETAILS SENT PROMPTLY ON REQUEST

CROWN RHEOSTAT AND SUPPLY COMPANY

3465 N. KIMBALL AVENUE • CHICAGO 18, ILLINOIS

INDICATE A 382.

Branch News

The regular meeting was called to order at 7:30 P. M. by PRESIDENT JOHN MILLHORN at Rodger Young Auditorium. There were 90 members and guests present. Nine new members were installed into membership. VICE-PRESIDENT STUART KRENTEL introduced 8 new applicants for membership. The meeting was then turned over to the librarian who introduced the speaker of the evening, WILLIAM A. VENSEL, whose subject was "Vapor Degreasing Prior to Plating and Organic Finishing."

He discussed the selection of proper degreasing equipment, methods of operation, safety factors, advantages of different kinds of degreasing solvent, conservation of solvent and short cuts to economical, rapid and thorough degreasing.

A lively question and answer period followed.

L. TRUMAN STONER, *Secretary*

LOS ANGELES BRANCH

The first regular meeting of 1954, held January 13 at the Rodger Young Auditorium, was called to order by PRESIDENT JOHN MILLHORN at 7:45 P. M. with 106 members and guests present.

JOSEPH TULUMELLO, MARTY BARSOOM, ROBERT J. SCHLOSSER and ANDREW J. CHAPLO were installed into membership. Five new applicants were introduced for membership by VICE-PRESIDENT STUART KRENTEL.

EARL COFFIN reported the death of ERNEST FRANCIS, one of the members who contributed much to the forming of the LOS Angeles Branch. The death of AL SAVAGE was reported by DON BEDWELL and a moment of silence was observed.

Don Bedwell, Earl Coffin and WALTER BEHLENDORF were appointed to act as nominating committee for branch officers for 1954–1955.

GEORGE R. BOUFFARD, Barber-Webb Company, was the featured speaker of the evening. His subject was "Corrosion Prevention, Linings and Coatings for Processing Units." He discussed the applications of vinyls, phenolics, furanes, epoxies, polyesters, asphalts, acid and carbon brick, Neoprene and rubber resin blends to processing equipment.

An invitation is extended to those interested to attend the Educational Session and Dinner-Dance to be held at the Ambassador Hotel March 20, 1954. Featured at that meeting will be four speakers obtained by LIBRARIAN G. MAGUREAU. The speakers: DR. H. BROWN, of the Udylite Corp.; ROBERT COUCH, United Chromium Inc.; R. W. MOULTON, Beckman Instrument Inc.; MYRON DIGGIN, Hanson-Van Winkle-Munning Co.

L. TRUMAN STONER, *Secretary*

LOUISVILLE BRANCH

A regular meeting was held November 19 at Korfhage's Restaurant. PRESIDENT P. H. PATE opened the meeting at 8:00 P. M. with 25 members and guests present.

WILLIAM B. DRAKE, member of the Tri-State Regional Meeting Committee composed of the Dayton, Columbus, Cincinnati, Indianapolis and Louisville branches reported that an annual meeting of these branches will be held April 3, 1954, at Cincinnati, Ohio. There will be a plant visitation in the morning with a hotel luncheon and a speaker at the Educational Session.

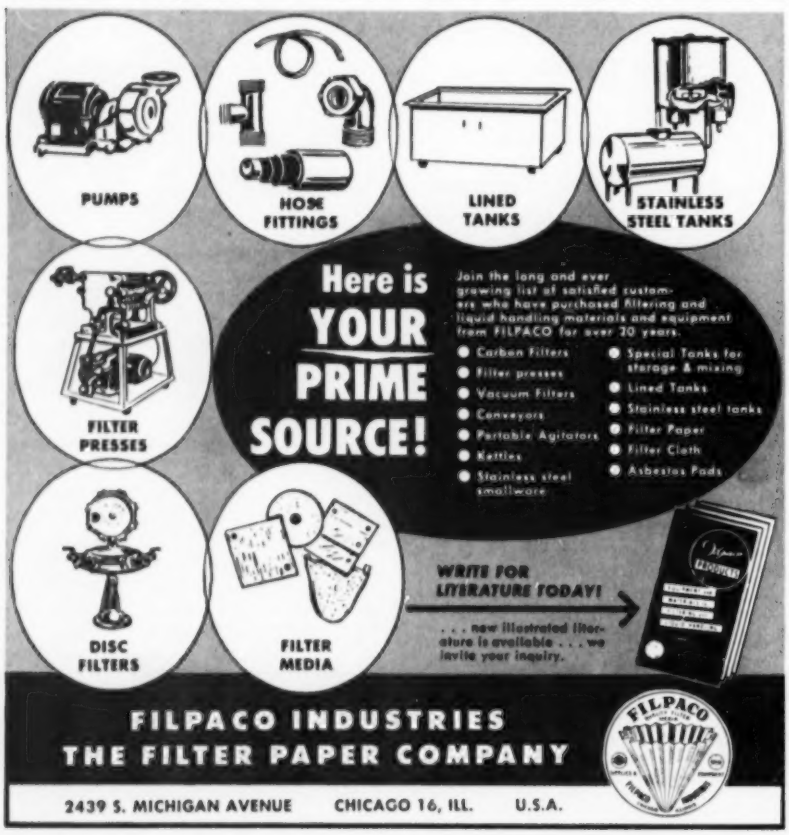
Voted into membership were: R. D JACKSON, L. H. WILLOUGHBY and E. E. WILLUWEIT.

A General Electric film entitled "Principles of Electricity" was shown.

EDUCATIONAL CHAIRMAN S. BEYER introduced EXECUTIVE SECRETARY P. PETER KOVATIS who gave an interesting talk, supplemented by a graph presentation of the growth of the Society from 1913 to this date. He cited the fact that the Society grew from 100 members in 1913 to over 6,000 in 1953 with more than 40 branches located in the principal cities of the U. S., Canada and Australia. He emphasized that numbers of members were not as important as member interest fulfillment by branches. "Too many organizations are more interested in signing up members and in collecting dues than in filling as many members' interests as possible," he said. Kovatis pointed out that it is most important to provide education at regular branch meetings but that education along technical lines was not enough. He suggested speakers from community and civic groups, sports circles and talks on subjects such as atomic energy, public relations and other timely topics. Kovatis urged joint meetings and functions with other branches and deemed regional get-togethers a very important internal public relations activity.

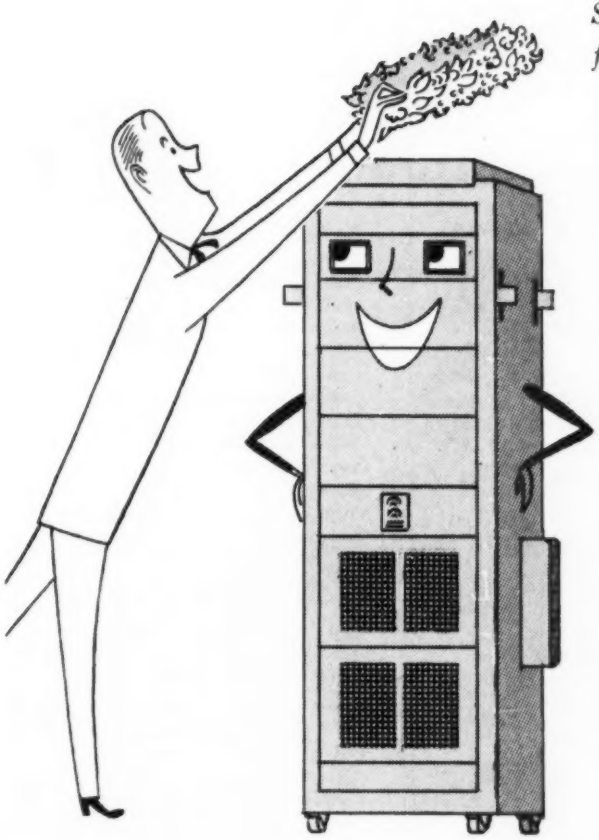
As Managing Editor of PLATING, Kovatis emphasized the importance of Branch News. "People want to see their names in print—it's a natural thing to expect. It's something newspapers thrive on. It's something we should offer our members, too," he said. "But branches should help us more by sending news more promptly and more often." He said that over 8,000 copies of PLATING are published monthly—a proof that PLATING is big business. The Executive Secretary said that the average member gets over $6 worth of magazine for about $2 a year. He explained that of the $5.70 which the Branch sends the National Office, $2 goes to PLATING, $1 to Research and $2.70 to defray the expense of running the Society.

The December meeting was recessed due to the proximity of the meeting date with Christmas activity. For those stalwarts who attend every meeting, a spe-



DID YOU KNOW?

NEARLY EVERY FEATURE NOW AVAILABLE ON ELECTROPLATING RECTIFIERS WAS ORIGINATED BY GREEN ELECTRIC—AND MOST OF THESE OVER A DOZEN YEARS AGO



Some of the standard and special features in Munning-Green Rectifiers:

- Skyscraper cabinets to save floor space
- Caster mounting to simplify installation
- Meters and lamps at eye level
- Controls and pushbuttons at hand level
- Twin pairs of output terminals
- Automatic current overload protection
- High temperature visual and audible warning signals
- High temperature automatic shutdown
- Anti-single-phase protection
- Downdraft cooling
- "L" circuit for low ripple and high efficiency
- Dual input
- Dual, triple and quadruple output
- Pushbutton remote control
- Automatic voltage stabilization
- Automatic current stabilization
- Automatic ampere-hour control
- Automatic time control
- Factory-tested at full load
- Detailed instruction book
- Unconditional two-year guarantee

MUNNING-GREEN RECTIFIERS

. . . Best in the World!

EXCLUSIVE SOURCE:

MUNNING & MUNNING INC.

202-208 EMMET STREET, NEWARK, N. J.

(Sales offices and distributors in principal cities)

Branch News

cial showing of a full length film was given on December 17 in the auditorium of the Speed Scientific School, University of Louisville. The film entitled "Corrosion in Action" was produced by the International Nickel Company. It presented in vivid graphic style how and why galvanic corrosion takes place. A better understanding of the galvanic series of metals, and the factors affecting corrosion rates was gained by all who were fortunate enough to witness this excellent film.

Following the film, members and guests met at the Parkmoor Recreation Center for refreshment. As a Christmas gift to the Louisville Branch, HARVIE JOHNSON, Belke Manufacturing Company, reached out from Chicago and picked up the check.

STANLEY J. BEYER, *Librarian*

MILWAUKEE BRANCH

On December 4 an overflow crowd attended the speakers' dinner given in honor of R. V. VANDENBERG. Forty members and guests enjoyed chatting with the speaker at the premeeting dinner.

To accommodate the speaker's plane schedule, LIBRARIAN JOHN SCHNEIDER introduced R. V. VandenBerg, Aluminum Company of America, before the regular business meeting. His subject covered the "Plating and Anodizing of Aluminum Alloys." Discussion of various plating baths with color slides to illustrate points, made the plating on aluminum seem to be an easy yet tricky job. The latter part of the evening was devoted to anodizing. Different aspects of the commercial sulfuric, chromic, and Alumilite processes were presented in Van's discussion and slides. The 104 members and guests enjoyed a lively and informative question period.

After VandenBerg's departure a short business meeting was opened by FRED ANDERSON, President. Five applicants were accepted as members, and 2 amendments to the by-laws were unanimously adopted.

After the announcement that refreshments would be served through the courtesy of the Aluminum Company of America, the meeting was adjourned.

C. PETER, *Assistant Secretary*

MILWAUKEE BRANCH

The Milwaukee Branch, fully realizing the importance of electing men of exceptional ability to the Executive Board of the Supreme Society, wishes to enter the name of LESLIE DIVELEY as a candidate for the office of Third Vice-President.

An examination of his record reveals that he has had a versatile career and a more than suitable background.

Diveley

His first experience with metal finishing came when he was employed at the Adams-Westlake Co. in Elkhart, Ind. He then took an attractive apprenticeship job in the distribution engineering department of the Indiana and Michigan Electric Company. At the early age of 21 he was made superintendent of one of that company's outlying properties. This position gave him experience in public relations, merchandising, office management, accounting, electrical maintenance, and power and light distribution.

His interest in chemistry continued however, and he enrolled at the University of Chicago.

He then returned to Elkhart as plating chemist for the Chicago Telephone Supply Company and later went to the Studebaker Corporation in South Bend where he aided in the design of plating departments of aviation plants. In 1941 he was made chief chemist of the Studebaker Aviation Gear Plant. While in Fort Wayne, Diveley served as Secretary and also as President of the Chemists Club and founded and edited the section magazine called the RETORT.

In 1945 he moved to Milwaukee as finishing engineer for Cutler-Hammer, Inc. During the eight years he has lived in Milwaukee, Diveley has been most active in our branch. Besides holding various branch offices, he served excellently

WELL PLATO, I HAVEN'T SEEN YOU SINCE WE LOADED THAT BOXCAR FOR OVERSEAS SHIPMENT—
LOOK LOUIE - HOW DO YOU THINK JOE GLO AND I GOT INTO THE SERVICE?
—AND DID YOU RUN AFTER A LOT OF GIRLS?
WHEN THERE WERE A LOT — I WALKED
HEY TONY! - YOU'RE GOIN' THAT WAY - TAKE ONE OF THESE CARTONS ON THE DOCK!
SULFURIC ACID
YEAH! — AN SHOVE TWO DUSTERS IN YOUR EARS AND CLEAN THE WALLS!
— BUT - PLATO - I CLEANED THE ADNOIDS - POURED IN MORE GUK AND DIDN'T TOUCH ANYTHING ELSE LIKE YOU TOLD ME —
— LOOK HERE MR. KELLY WERE YOU HELPING JOE GLO CLEAN THAT DEGREASER AGAIN?
DOSTALE

as Educational Chairman for the 1949 Convention. Our monthly NEWSLEAF was founded and edited by him.

At the present time, he is a member of the Editorial Board of PLATING and of Committee B-8 of the ASTM.

The Cutler Hammer Corp. endorses the branch's plan to present Diveley's name for nomination as Third Vice-President. They have agreed to grant him all the time and support he will need to successfully carry out his duties should he be elected.

E. E. PIELLUSCH,
Secretary-Treasurer

NEW YORK BRANCH

The meeting held December 11 at the Hotel Statler, New York, was called to order by PRESIDENT A. AMATORE.

President Amatore had the pleasure of announcing the following visitors: D. G. FOULKE, AL KORBELAK, BOB EHRHARDT and GUS BITTRICH, all from the Newark Branch.

Also announced was the presence of M. FANNON, one of our old timers, who for some time has been on the absentee list, due to ill health, but is now back in fine shape.

Elected to membership and duly installed were: R. IPPOLITO, F. GALLAWAY, H. PORISI, H. C. SCHNEIDER, S. MAYNARD, H. KASHMAN.

The meeting then was turned over to LIBRARIAN P. VEIT, who, in turn, presented LOU DONROE of Newark Branch who conducted an excellent question and answer session.

LESTER LEVINSON,
Recording Secretary

PITTSBURGH BRANCH

A regular meeting was held on October 7 at the Sheraton Hotel with 25 present for the premeeting dinner. PRESIDENT WASHBURN opened the meeting and turned the educational part of the program over to LIBRARIAN MYRON CERESA. The speaker for the evening, A. W. LOGOZZO, Nutmeg Chrome Corp., presented a very fine talk on "Hard Chrome Plating."

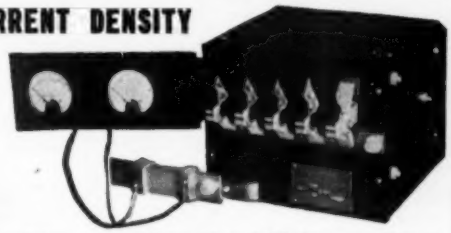
At the November 4th regular meeting 3 new applications for membership were received and 5 new members were voted into the branch.

An unusually large group gathered to hear R. V. VANDEN BERG, of the Aluminum Co. of America, New Kensington, Pa., one of the branch members, give a fine talk on the various finishes and applications for aluminum. His subject was entitled "Finish Systems for Aluminum Alloys."

At the regular meeting held on December 2, there were 15 present for dinner, and 35 for the business meeting. RUDY SCHINDLER presided and the following applications were approved: ALBERT DAMALAK, KENNETH F. HITTLE, and JOHN TUCKER.

FOR THE RIGHT CURRENT DENSITY

USE COLUMBIA TANK RHEOSTATS



It's easy to adjust your tank voltage to suit the load with a Cast Grid Type Columbia Tank Rheostat. Standard sizes from 15 to 5000 Amperes, 1 to 6 Volt drop. Other voltage drops as specified.

COMPARE THESE OUTSTANDING FEATURES

- Cast Grid Resistors, rugged and resistant to chemical fumes.
- Cam Operated Toggle Switches, quick break, self-cleaning, positive contact, readily accessible, easily operated.
- Rugged construction and liberal design provide ample capacity for intermittent and momentary overloads.
- Entire rheostat, including instruments, easy to install.

WRITE FOR BULLETIN PL-500

COLUMBIA ELECTRIC MFG. CO.

4533 HAMILTON AVENUE CLEVELAND 14, OHIO

Also Manufacturers of Motor Generator Sets, Reversing Switches, Tong Test Ammeters

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 385.

YOU CAN START RIGHT EVERY TIME WITH PERMAG

Cleaning tanks, so important to improved production and faster operation, are the first units in producing uniform work for a uniform plate.

Offering every advantage you seek for this work, PERMAG will leave your job chemically clean without damage to the metal and at a minimum cost for maximum cleaning efficiency.

Our technical service staff will gladly consult with you on any cleaning problem you may have, without obligation.

Write for your FREE Electroplaters' Handy Pocket Size Manual on Cleaning Compounds.

If you have trouble with: HAZY DEPOSITS, BLISTERS, PEELING, CARRY-OVER, CORROSION or SMUT ON STEEL —let us help you.

MAGNUSON PRODUCTS CORPORATION

50 Court Street • Brooklyn 2, N. Y.

In Canada:
CANADIAN PERMAG PRODUCTS, LTD., MONTREAL

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 386.

The guest speaker, Dr. R. A. Schaefer of the Clevite Brush Development Co. and AES 1st Vice-President was introduced by Librarian Ceresa. Dr. Schaefer spoke first of some of the business problems confronting the National Society, after which he gave an interesting paper entitled "Selected Cathode Shapes and Metal Distribution."

William D. Wilson, *Secretary*

PROVIDENCE-ATTLEBORO BRANCH

The January 18 meeting was held at the Providence Engineering Hall at 8:30 P.M.

John Clarner was elected to head the nominating committee and a slate of officers is expected at the next meeting.

After a short business meeting, President George Gibbs introduced the guest speaker for the evening, Walter H. Prine, who chose for his topic of the evening, "Industrial Aspects of Nickel Plating."

Prine went into great detail describing the various types of solutions and their uses in industrial nickel plating.

As to be expected a very lengthy question and answer period followed. The meeting adjourned at 10:30 P.M. with 28 members and guests present.

Henry Shavier, *Secretary*

ROCHESTER BRANCH

On December 19 over 100 members and guests of the branch enjoyed the annual Christmas party. It was held at the Liederkranz Club and started at 6:30 P. M. with a dinner of prime ribs of beef and all the trimmings. Music was provided during the dinner hour by an accordionist, and later by Bill Kerns Orchestra for the dancing. Gifts were presented to everyone through the courtesy of local suppliers. A vote of thanks from all those present is due the party committee, Vern Schaeffer, Don Blum and Ray Berghold.

The January 18 meeting was held at the 40 & 8 Club. In the business session Platt K. Wiggins, Jr., was welcomed into Society membership by application and Lorin Correll by transfer from the Cleveland Branch. A moment of silence was observed in memory of George Hogaboom whose death was announced at the meeting.

The speaker of the evening was A. H. Griffin of Wallace & Tiernan Co., who spoke to the group on "Cyanide and Chromium Waste Disposal Methods and Equipment." Griffin demonstrated his wealth of experience in the field of water treatment and waste disposal in ably presenting this topic.

Ed Wallin, *Secretary*

ROCKFORD BRANCH

A regular meeting was held December 14 at the Faust Hotel. Twenty-five members and guests were present for the dinner and 37 were in attendance for the business meeting and technical session, which followed.

The membership application of Francis Bryant, field engineer, Udylite Corp., was read and accepted. The date for the annual educational session and dinner-dance was announced: April 3, 1954 at the Faust Hotel.

Leonard Weeg introduced Mr. Gilbertson, Past President of the National Society and life-time honorary member of the Chicago Branch, who talked on the "History of Electroplating." The speaker brought out many points of interest on electroplating, after which he answered a round of questions.

Robert Twyning of the Twyning Chemical Co., showed films of his recent trips to Mexico City and the Canadian Rockies.

A monthly meeting was held on January 11 at the Faust Hotel. Donald Meserve of United Chromium Inc. gave a well-received talk on "New Developments in Organic Finishing." A great deal of up-to-date information was covered in this talk and much discussion followed. The reason behind the failure of organic coatings really elicited a host of questions.

Lawrence Ray of Barber-Colman gave a short talk on how metal finishing fits into the operations at this local plant. This was the first of a series in which local members will be asked to discuss metal finishing. Ray's discussion certainly taught many of our members new facts about a plant that they had been familiar with for many years, but had never really known.

Our Annual Meeting will be held on April 3, 1954 at the Faust Hotel.

E. J. Budden, *Secretary*

a good pattern
for you to follow
completely sealed
SELENIUM
RECTIFIERS
An analysis of the plants using SEL-REX equipment reveals an eye-opening picture – the majority of the hundreds of SEL-REX equipped plants are world-famous for the quality of their products. These companies represent practically every industry using plating . . . decorative and industrial.
Such an outstanding record cannot be ignored. Place your plant in the SEL-REX pattern and enjoy uninterrupted service WITHOUT costly maintenance. SEL-REX REACTRONICALLY CONTROLLED RECTIFIERS are sealed against dirt, moisture and corrosive fumes. There is a SEL-REX water-cooled or standard air-cooled rectifier for every application.
Literature and names of SEL-REX equipped plants on request. Write to Dept. PL-3
NEMA
BART-MESSING CORPORATION
229 Main Street
Belleville 9, N. J.
SEL-REX RECTIFIERS for every requirement from 25 to 50,000 amperes

Have you tried LIQUIMATIC?

"Controlled Compounds" in extruded bar and liquid to meet all requirements and conditions of any job.

the perfect liquid compound

Liquimatic®

for all finishing requirements on all metals

Check these features

- FAST CUTTING
- EASY CLEANING
- ADHESIVE, SLOW WEARING BUFF FACE
- NON-SETTLING
- HIGH FLASH POINT
- LONG STORAGE LIFE
- SPRAYABLE VISCOSITY

J. C. Miller Engineers are fully qualified through technical training and years of practical experience to demonstrate and recommend materials and methods for use in your plant — materials and methods that pay you big dividends in higher production and increased savings.

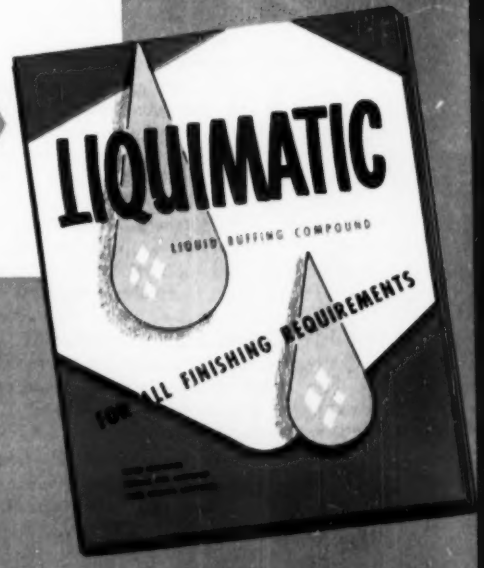
Our Buffing Engineers are equipped with portable Liquimatic demonstration kits which enable them to easily show you the savings that Liquimatic can effect in your plant — on your production line. This demonstration equipment is rapidly set up, requires no assistance from your help and the test can be made on hand lathes or automatic equipment using just a compressed air connection. The demonstration in no way impedes your normal production flow.

Here is a demonstration you should see regardless of past experience or whether or not you are using a liquid compound at present! We know that we can show you that we have achieved the maximum in performance through combining the very latest in automatic application equipment with the very best in compounds — Liquimatic. This is the Liquimatic team — an unbeatable combination.

Send today for your copy of the big, new Liquimatic and Liquimatic Automatic Equipment Brochure. It's full of valuable information for the metal finisher.

LIQUIMATIC . . .

LETS YOUR BUFFS LIVE LONGER



J. C. Miller Quality & Service

Manufacturers of

Tripoli • Stainless Steel Compound • Lime Finish • Cut and Color • Chrome Rouge • Greaseless • Grease Stick • Emery Cake • Burring Compounds

J. C. MILLER Company

631 Chestnut Street

GRAND RAPIDS, MICHIGAN

Branch News

SAGINAW VALLEY BRANCH

The January 13 meeting was held at Zehnder's Hotel in Frankenmuth, Mich., and was attended by 89 members and guests.

During a short business session, which was opened by PRESIDENT MANUEL BEN, 9 new members were introduced. This brings total membership to 114.

GEORGE CARTER introduced the guest speaker for the evening, DR. W. L. MCCRACKEN of the Detrex Corp. Dr. McCracken's topic was "New Development in Modern Cleaning Techniques."

After a discussion of a brief history of metal cleaning, two of the more modern methods, periodic reverse current and sonic cleaning, were explained. With the aid of slides, the manufacture of materials used, type of solutions, mechanics, process, and views of present installations were discussed. Demonstrations were given on both types of cleaning methods.

G. PAUL BEARDSLEY,
Recording Secretary

SAN FRANCISCO BRANCH

The annual Christmas party was held again this year at the Italian Village on December 11. Approximately 26 couples attended.

Dinner was served before, and during, the floor show. Entertainment consisted of "The Borah Minnevitch Harmonica Minstrels" and "The Four Ramses" from Egypt. The floor show was very popular with the audience, and after the floor show the drawing for the numerous door prizes was held.

The party was a success and everyone seemed greatly pleased.

The San Francisco Branch wishes to thank those people who cooperated in making the party a success.

HORACE J. SMITH,
Secretary-Treasurer

SPRINGFIELD BRANCH

The January 25 meeting was started at 8:00 P. M. by PRESIDENT ED KOETSCH and immediately turned over to LIBRARIAN JOHN GREENAN who introduced N. S. CHAMBERLIN, chemist, Wallace & Tiernan Co., Newark, N. J. His subject was "Cyanide and Chromium Waste Disposal." The subject was presented very well and was accompanied by slides.

ROGER HEROUX, *Secretary*

ST. JOSEPH VALLEY BRANCH

A regular meeting was held at the Hotel Elkhart, on December 2 with 31 members and guests present for the dinner and 35 at the technical session.

Two applicants were elected to active membership: WILLIAM L. BONOUGH, chemist, Bendix Aviation Corp., and JAMES H. ROWE, plater, South Side Plating Works.

Two applications were received: JAMES WOLFE, sales engineer, Haviland Products Co., and GEORGE STAHL, plater, Excel Corporation.

JOHN LOCKERBIE gave a report on the Chicago meeting for discussion of the expansion of AES to include other finishing in addition to plating.

RALPH BROUWER reported on the progress of plans for Ladies' night.

PRESIDENT WILLIAM MCDOWELL opened the meeting for the usual ten minute discussion. Question one by BILL MCDOWELL was—"How can you lower the *p*H of cyanide copper solutions?" The use of tartaric acid was suggested by DR. WILHELM. RAGUE suggested the use of sulfuric acid although this might require some very difficult safety precautions. POUCHER suggested that ½ of the solution be siphoned and then the rest built up after dilution to the correct *p*H. The stored solution is used as make-up later.

The second question by DEARTH was on trouble of sealing die-cast aluminum parts prior to plating. Answers: by CLEMANS—*p*H of sealer might be off, or small quantities of acid may be carried over from acid rinse; by OSWALT—lower the temperature to not more than 68°; by SHAFER—perhaps stray currents in bath cause the problem.

The third question by BALDWIN brought up the problem of Indiana State Conservation Dept. and Public Health Department requirements on waste control and water back-up. A lively general discussion followed with a multitude of additional questions raised.

Poucher then introduced the guest speaker, R. Dow, United Chromium, Inc., who presented the paper, "Crack-Free Chromium Plating," which was essentially the same material as published in the Dow-Stareck paper in the September issue of PLATING.

EUGENE ROTH, *Secretary-Treasurer*

SYDNEY BRANCH

The November meeting was held at the Trust Building, with 18 members present. This was election night, and the following were elected for the year 1954:

President—W. MILLWARD
First Vice-President—J. MURPHY
Second Vice-President—J. LEAN
Secretary-Treasurer—J. TAYLOR
Librarian—B. BRIDGEMENT
Board of Managers—B. ARMSTRONG, D. FACER, J. JONES

The Christmas smoker this year was one of the best nights for a long time. It was held again at the Roselands Golf Club and with 112 in attendance the night started off to a good swing with a grand dinner. After this the entertainers took charge and the magician was well applauded for his tricks and entertaining. The rest of the night was then free for the members and visitors to mingle with each other and discuss everyday plating and general problems. The one-armed machines had full attention, although it is hard to see how the little plating which was on them could hold the interest of the platers all night.

Becoming serious again, nights like these or more social activities could bring new members and also help to create an interest to hold our delinquent members, who have a tendency to stray. If these functions could be arranged it should help to bring members back together again.

B. W. BRIDGEMENT, *Secretary-Treasurer*

SYRACUSE BRANCH

The October 19 meeting was held at Richards Restaurant, Syracuse, N. Y., with 43 members and guests in attendance. A premeeting dinner of prime ribs of beef was enjoyed by 31 members.

JAMES VIOLA, President of Rapid Electric Co., speaker of the evening, spoke on "The Latest in Rectifiers." He sketched out about every circuit possible and covered the many types of controls used with rectifiers. Too many times we hear some one say they are going to buy a rectifier. But after this meeting they are going to be more specific. Viola pointed out that a rectifier could be custom made for a specific job for little or no additional cost. There was a long question and answer period making this a very good meeting.

Refreshments were served through the courtesy of Frederick Gumm Chemical Co., ED HOLLISTER host.

LINDLEY S. WOOD, *Secretary*

WATERBURY BRANCH

The Waterbury Branch would like you to know about a man we plan to endorse for the office of Third Vice-President of the Society at the 1954 Convention.

Eddy

His name is FRANCIS T. (FRANK) EDDY. Currently, he is President of the Waterbury Branch. Frank has served as General Chairman of the New England Regional Meeting; is presently Chairman of The National Paper Awards Committee and is scheduled to deliver a paper, "Plating Room Organization," before several of the Society's branches in the near future.

He is a vigorous individual with good organizational ability. A graduate of Brown University, Frank saw service as

(*Continued on page 328*)

Membership Report of the A. E. S.

Elections

BALTIMORE-WASHINGTON: Charles C. Barrett, George M. Bonnett, Mrs. Margaret A. Hilkert, John A. Jones, Williamson W. Moss, Edward J. Roach

BUFFALO: Kenneth J. Man, Richard E. Sampson, Robert W. Spencer

CHICAGO: Dan Abenanti, Paul F. Morley, Wayne G. Polzin, Edward Stone, Henry G. Zucker, Jr.

CLEVELAND: John M. Carpenter, Charles A. Frawley, Harold J. Fredrick, William B. Osborn, William A. Pardee, William R. Peate, Bob Scoville

COLUMBUS: Roger P. Cassidy, Douglas Gordon, Thomas F. Jackson, James G. Kitchen, Richard B. Lose, Marvin E. Pingel, William Reid, Jr.

DAYTON: Bennie Cohen, Robert C. Wolfe

DETROIT: Oscar P. Anderson, Ivan E. Baldwin, Robert T. Bergman, John T. Collier, Paul S. Cuolahan, Patrick J. Driscoll, Ben P. Freedland, Richard F. Gach, Frank J. Garrity, Thomas Q. Gorton, David W. Hardesty, William W. Hunlock, John A. Lisowski, Carl A. Lofstrom, Roger E. Marce, John J. O'Day, William J. Rein, William Shaw, Edward Tann, Jesse Villereal

INDIANAPOLIS: Jesse O. Hillock, Jr., Ira Williamson, Jr.

LANCASTER: P. Roberts Baker

LOS ANGELES: Marty Barsoom, Ardrew J. Chaplo, Robert J. Schlosser, Joseph Tulumello

NEW YORK: Ralph Ayala, Richard S. Baier, Philip H. Eisenberg, Frank W. Galaway, Joseph R. Ippolito, Henry Kashman, Scott Maynard, Henry R. Parisi, Dr. Francis Schmidt, Harold C. Schneider

PHILADELPHIA: John Huggins, Charles M. Jessee, Elmer J. McCarthy, Joseph T. Moran, Jr., Angelo D. Tentilucci

PITTSBURGH: Ezra E. Best, Jr., George Cacie, Albert Damalak, George J. Dawson, Arthur J. De Ninno, Kenneth F. Hittle, Leonard R. Hoak, Eugene C. Momeyer, William J. Musmanno, Lowell H. Parker, John Tucker

ROCHESTER: Platt K. Wiggins, Jr.

SAGINAW VALLEY: Gerald J. Carroll, Arthur P. Du Russell, Roy O. Henson, Paul J. Schiappacasse, Harris R. Shimel, Alvin A. Smith

ST. JOSEPH VALLEY: James Wolfe, George Stahl

SOUTHEASTERN: Olaf Olsen, Wilmont D. Tidd

SYDNEY: Clive J. Jones, Clement P. McCloskey, Maxwell A. Taylor

SYRACUSE: Jack Bension, M. Douglas Cameron, Victor Capogna, Raymond L. Howard, Edwin E. Wheeler

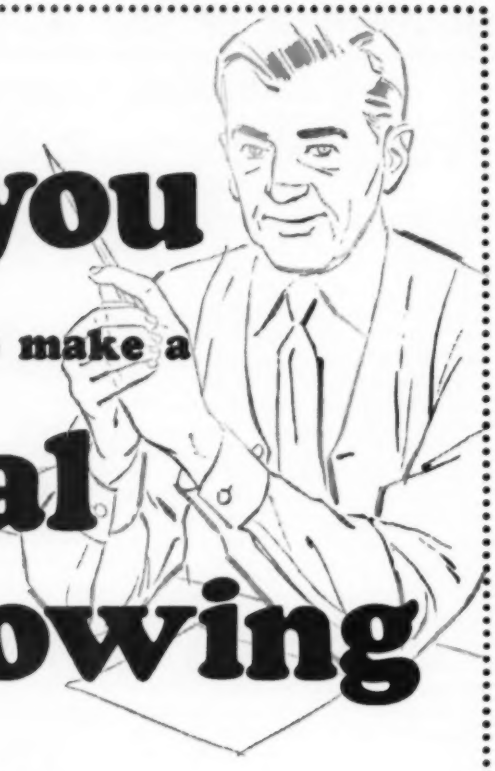
TOLEDO: Frank B. Barrett, Charles I. Ennis, Richard G. Volk, Paul Weaver

Membership Competition

BRANCH	Membership April 1, 1953*	New Members	Net Change in Membership	Per Cent Net Change	Sustaining Membership Credits
First Group					
Los Angeles	236	50	+41	+17.4	14
Pittsburgh	142	17	+13	+ 9.2	6
Detroit	504	67	+46½	+ 9.2	53
Newark	251	27	+22½	+ 9.0	11
New York†	352	44	+29½	+ 8.4	19
Hartford	151	19	+11	+ 7.3	5
Grand Rapids	173	12	+ 9½	+ 5.5	13
Philadelphia	198	24	+10½	+ 5.3	11
Cleveland	236	24	+ 6	+ 2.5	19
Waterbury	130	8	+ 2½	+ 1.9	16
Chicago	477	26	4	+ 0.8	83
Melbourne	169	19	+ 1	+ 0.6	..
Milwaukee	164	36	0	0	8
Boston	155	3	− ½	− 0.3	6
Bridgeport	158	9	− 3½	− 2.2	4
Toronto	146	14	−10	− 6.8	7
Second Group					
Dayton	76	13	+10½	+13.8	3
Syracuse	128	30	+17½	+13.7	4
Montreal	80	8	+ 8	+10.0	1
Indianapolis	105	17	+ 8	+ 7.6	1
Saginaw Valley‡	103	18	+ 7	+ 6.8	..
St. Joseph Valley	78	12	+ 3½	+ 4.5	1
Twin City	71	4	+ 2½	+ 3.5	1
Baltimore-Washington	93	13	+ 3	+ 3.2	4
San Francisco	74	15	+ 1½	+ 2.0	..
Sydney	82	11	+ 1	+ 1.2	..
Cincinnati	92	4	− 4½	− 4.9	2
Providence-Attleboro	95	3	− 5½	− 5.8	2
New Haven	100	..	− 6½	− 6.5	7
Buffalo	106	6	− 7½	− 7.1	2
Rochester	107	11	− 9	− 8.4	3
St. Louis	109	8	−18	−16.5	10
Third Group					
Columbus	52	9	+ 8½	+16.3	1
Springfield	57	10	+ 8	+14.0	2
Hamilton	25	3	+ 3	+12.0	4
Rockford	63	6	+ 6½	+10.3	3
Western Ontario	22	2	+ 2	+ 9.1	▲
Lancaster	69	4	+ 4	+ 5.8	2
Southeastern	50	4	+ 2	+ 4.0	1
Dallas-Fort Worth	53	6	+ 1	+ 1.9	2
Houston	42	1	+ ½	+ 1.2	1
Adelaide	52	6	0	0	..
Jackson-Lansing	61	3	0	0	1
Kansas City	46	6	0	0	..
Toledo	56	10	0	0	3
Louisville§	44	3	− 2½	− 5.7	2
Allentown-Reading	53	..	− 4	− 7.5	6
Wichita	41	5	− 7	−17.1	2
Canadian Branches, unallocated					8
Other credits to be allocated					2
Outside Competition					
Portland	...	18	.....	.....	..
At Large	138	23	+20½	.....	..
Total AES	6,065	691	+255	+ 4.2	359

Active Membership, January 31, 1954 6,320

*Subject to correction. †, ‡, §Winners in first, second and third groups, respectively of 1952–1953 membership competition. ▲Proper credit to individual Canadian Branches not available.



if you want to make a real showing in your plating

Ask MEAKER

With over fifty years' experience manufacturing automatic plating machines custom built for highest production at lowest unit cost for some of the largest plating departments, MEAKER has the know-how to help you make a real showing in your plating. For the complete story, ask The Meaker Company, 1639 So. 55th Ave., Chicago 50, Ill.

MEAKER PRODUCTS

Full Automatic and Semi-Automatic Electroplating Equipment
Batch-Type Continuous Electroplating Machines
Strip Steel Plating Equipment • Wire Galvanizing Equipment
Pickling Machines • Process Conveyors
Motor Generators and Rectifiers

Special Machines for the Unusual Requirements

WATERBURY: Patrick R. Mazzamaro, Nicholas A. Topazio
MEMBER-AT-LARGE: Phillip E. Durrant, Warwick, England; Walter H. Kresge, Royal Oak, Mich.

Reinstatements

BUFFALO: J. J. Fusco, Henry McConnell
COLUMBUS: Paul Zang (returned from the Army)
ROCHESTER: Henry Burns, William Kushner

Transfers

David Kilmurray to San Francisco from Buffalo; E. L. Huber from Detroit to Columbus; William A. Donakowski to Saginaw Valley from Detroit; Harold A. Kahler to Hartford from Detroit; Edmund J. Quinlan to New York from Detroit; Robert A. Stewart to Saginaw Valley from Jackson-Lansing; W. D. Jeffries to Syracuse from New York; Lorin E. Correll from Cleveland to Rochester;

Resignations

ADELAIDE: M. C. Stewart
CHICAGO: Raymond M. Sides
CINCINNATI: Christian M. Greiner
SAN FRANCISCO: Marvin O. Crawford

Suspensions

ROCHESTER: Dean Van Ostrand
SAGINAW VALLEY: Gray Bernard, Ernest Boehr, H. J. Breithart, Dale V. Burdy, John Dzuvura, John M. Fe-,lisky, Glen Fitzgerald, Don W. Smith
SPRINGFIELD: Arthur Copp

Deaths

HARTFORD: George B. Hogaboom
LOS ANGELES: Ernest Francis
NEW HAVEN: Howard E. Christie
NEW YORK: Harry Sussman
SAGINAW VALLEY: John A. Spaulding
SAN FRANCISCO: Joseph LeRoy

Branch News

(Continued from page 326)

a Naval Officer in the South Pacific in World War II. He joined the Chase Brass & Copper Company in Waterbury in 1946 as Superintendent of Finishing and is today Assistant Plant Superintendent of the Manufacturing Division of the Company. At one period he supervised all finishing operations for Chase.

We all know the importance of having men with good administrative ability to help run the Society's affairs. We also believe that officers should not always be concentrated in the large city branches.

We intend to propose Frank Eddy's name at the Interim Meeting in Toronto in February. We expect that his name will go before the New York City Convention in July.

S. L. Henn, *Secretary*

Directory of A. E. S. Officers and Research Chairman Branch Secretaries and Research Chairmen

A. E. S. OFFICERS

President.....Dr. G. P. SWIFT
53 Galen Street, Watertown 72, Mass.

First Vice-President.....Dr. R. A. SCHAEFER
Clevite-Brush Development Co.,
Division of Clevite Corporation
17000 St. Clair Avenue, Cleveland 10, Ohio

Second Vice-President.....CLYDE KELLY
Superior Plating Works
4600 Palmer St., Chicago, Ill.

Third Vice-President....DR. SAMUEL HEIMAN
Philadelphia Rust Proof Company
3221 Frankford Avenue, Philadelphia 34, Pa.

Past President.....F. J. MacSTOKER
Farrand Optical Company, Inc.
4401 Bronx Boulevard, Bronx, N. Y.

Executive Secretary.....P. PETER KOVATIS
445 Broad Street, Newark, N. J.

A. E. S. RESEARCH COMMITTEE

Chairman.....DR. EARL J. SERFASS
Lehigh University, Bethlehem, Pa.

Secretary.....The Executive Secretary

Ceilcrete

FOR

FLOORS, TANKS AND TRENCHES

A NEW ACIDPROOF COATING FOR CONCRETE

CEILCRETE surfacing provides the same protection as more costly acidproof brick in most applications. It hardens to a stone-like surface which withstands trucking, foot traffic and erosion from hot solutions and steam. CEILCRETE floors have four times the load carrying strength of ordinary concrete. CEILCRETE is easily applied by troweling to all types of concrete surfaces: flooring . . . pipe, tank and trench lining . . . cement block . . . walls . . . pump bases . . . waste disposal systems. Available as materials or a complete job on contract basis.

- ACIDPROOF
- ALKALIPROOF
- SOLVENTPROOF
- HIGH IMPACT STRENGTH
- ABRASION RESISTANT
- EROSION RESISTANT
- NONSPARKING
- NONSLIP
- ADDS NO WEIGHT

1660-CC

Write today for illustrated Bulletin 110

THE CEILCOTE CO.
CORROSION PROOF MATERIAL AND CONSTRUCTION

4842 RIDGE ROAD
CLEVELAND, OHIO

for better ACID TANK HEATING *at lower cost*

- No stray currents ...for precision hard chrome and bright nickel plating.
- No heat lag—no heavy casing to absorb electrical energy.
- Electrical radiant heat eliminates usual fog and fumes over tank.
- Constant, dependable controlled heat.

- Low initial cost.
- Low operating cost.
- Longer life.

Clepco

G-SERIES FUSED QUARTZ

IMMERSION HEATERS

Clepco is the only fused quartz immersion heater recommended and sold by all leading Plating Supply Houses. There are more than 40,000 Clepco fused quartz immersion heaters in service throughout the U.S.A. That's positive proof of satisfaction and dependability.

Wide range of standard sizes to meet every need. Ask your Supply House for Clepco literature, or write direct to us.

For alkaline solutions, specify Clepco heavy duty series W Steel Jacketed Immersion Heaters.

CLEVELAND PROCESS COMPANY
1965 EAST 57TH ST. • CLEVELAND 3, OHIO

Index to Advertisers

ACME MFG. CO., INC. 293
Agency: Rex Dye
ALLIED RESEARCH PRODUCTS, INC. 235
Agency: Emery Advertising Corp.
ALMCO DIVISION, QUEEN STOVE WORKS, INC. 297
Agency: Weston-Barnett, Inc.
ALSOP ENGINEERING CORPORATION 249
AMERICAN CHEMICAL PAINT CO. 223
Agency: May Advertising Company
AMERICAN ELECTROPLATERS' SOCIETY 317

BACON FELT COMPANY 242
Agency: F. P. Walther, Jr., & Associates
BAKER & ADAMSON PROD., GENERAL CHEMICAL DIVISION, ALLIED CHEMICAL & DYE CORP. 243
Agency: Atherton & Currier, Inc.
M. E. BAKER COMPANY 256
BART-MESSING CORPORATION 324
Agency: Bass and Company, Inc.
BEACON SUPPLY COMPANY 313
Agency: Asher, Godfrey & Franklin
BEAM-KNODEL COMPANY 292
BECKMAN INSTRUMENTS, INC. 228
Agency: Darwin H. Clark Co.
BEHR-MANNING CORP. (NORTON CO. DIV.) 229
Agency: Peterson & Kempner, Inc.
BELKE MANUFACTURING COMPANY 253
Agency: Allbright Associates
BETTER FINISHES & COATINGS, INC. 232
Agency: James J. McMahon, Inc.

CEILCOTE COMPANY 329
Agency: Penn & Hamaker Adv.
CHANDEYSSON ELECTRIC COMPANY 247
Agency: Oakleigh R. French & Associates
THE CHEMICAL CORPORATION 244, 256
Agency: Wm. B. Remington, Inc.
CHEMICAL PRODUCTS CORP. 288
Agency: George T. Metcalf Co.
CHEMSTEEL CONSTRUCTION COMPANY, INC. 332
Agency: Smith, Taylor & Jenkins, Inc.
CLEVELAND PROCESS COMPANY 329
Agency: Scheel Advertising Agency
F. L. & J. C. CODMAN COMPANY 234
Agency: Sanderson Brothers
COLUMBIA ELECTRIC MANUFACTURING COMPANY 323
Agency: Meermans, Inc.
THE CRO-PLATE COMPANY 302
Agency: Fairbairn & Company, Inc.
CROWN RHEOSTAT & SUPPLY COMPANY 319
Agency: Saunders, Shrout & Associates, Inc.

DAVIES SUPPLY AND MFG. CO. 294
Agency: Batz, Hodgson- Neuwoerner
THE DIVERSEY CORPORATION 295
Agency: Russel M. Seeds Company
DU-LITE CHEMICAL CORPORATION 248
Agency: Charles Palm & Co.
E. I. DU PONT DE NEMOURS & CO., INC. 237
Agency: Batten, Barton, Durstine & Osborn, Inc.

ENTHONE, INCORPORATED 219
Agency: Hugh H. Graham & Associates, Inc.
THE EXOLON COMPANY 250
Agency: Melvin F. Hall Advertising Agency, Inc.

FILTER PAPER CO. 320
Agency: Sander Rodkin Adv. Agency
FORCITE CORPORATION 332
Agency: Ralph M. French
FORMAX MANUFACTURING COMPANY 222
Agency: Brindley-Roth, Inc.

GENERAL ELECTRIC COMPANY 239
Agency: G. M. Basford Company
W. GREEN ELECTRIC DIV., MUNNING & MUNNING INC. 321
Agency: Shappe-Wilkes, Inc.
FREDERICK GUMM CHEMICAL COMPANY, INC. ..... 2nd Cover
Agency: Schniedenbach Studios

HANSON-VAN WINKLE-MUNNING COMPANY ..... 4th Cover
Agency: O. S. Tyson & Company, Inc.
HARRISON & COMPANY 298
THE HARSHAW CHEMICAL COMPANY 260
H. N. HARTWELL & SON, INC. 311
Agency: H. B. Humphrey, Alley & Richards, Inc.
R. O. HULL & COMPANY, INC. 221
Agency: Ralph M. French Advertising

INDUSTRIAL FILTER AND PUMP MFG. CO. 238
Agency: Merrill, McEnroe & Associates, Inc.

JOE D. BUFF 306

KLEM CHEMICALS, INC. 254
Agency: Burke Bartlett Company, Inc.
KOCOUR COMPANY 236
Agency: DeCaseres & Associates

KOPPERS COMPANY, INC. 251
Agency: Batten, Barton, Durstine & Osborn, Inc.
JOSEPH B. KUSHNER 292

THE LEA MANUFACTURING COMPANY 299
Agency: Sanger-Funnell, Inc.
LEA RONAL, INC. 227
Agency: Sanger-Funnell, Inc.
CHARLES F. L'HOMMEDIEU & SONS CO. 241

MAC DERMID, INC. ..... 3rd Cover
Agency: Jackson-Hall Company
MAGNUS CHEMICAL COMPANY 226
Agency: Spooner & Kriegel
MAGNUSON PRODUCTS CORPORATION 323
Agency: Asher, Godfrey & Franklin, Inc.
MANHATTAN RUBBER DIVISION 255
Agency: The Roland G. E. Ullman Organization
MASTERS' ELECTRO-PLATING ASSOCIATION, INC. 300
THE MEAKER COMPANY 328
Agency: Merrill, McEnroe & Associates, Inc.
MICHIGAN BUFF COMPANY, INC. 296
MICHIGAN CHROME AND CHEMICAL COMPANY 301
THE MILBURN COMPANY 248
Agency: W. B. Doner & Co.
J. C. MILLER COMPANY 325
Agency: James Philip Reed
MINNESOTA MINING & MANUFACTURING COMPANY 257
Agency: Batten, Barton, Durstine & Osborn, Inc.
MURRAY-WAY CORPORATION 245
Agency: F. B. Hubert Adv. Counsel
MUTUAL CHEMICAL COMPANY OF AMERICA 240
Agency: House of J. Hayden Twiss

GEORGE L. NANKERVIS COMPANY 230
Agency: Charles M. Gray & Associates

OAKITE PRODUCTS, INC. 290
Agency: Rickard and Company

THE PATENT BUTTON COMPANY 244
Agency: Edward Gracesman & Associates
PENNSYLVANIA SALT MFG. CO. 303
Agency: Geare-Marston, Inc.
THE PIONEER RUBBER COMPANY 296
Agency: Carr Liggett Adv., Inc.
POWERS REGULATOR COMPANY 224-225
Agency: Symonds, MacKenzie & Co., Inc.
PROMAT DIVISION, POOR & COMPANY 231
Agency: Russell T. Gray, Inc.

RAYBESTOS-MANHATTAN, INC., MANHATTAN RUBBER DIV. 255
Agency: The Roland G. E. Ullman Organization
ROBERTS ROUGE COMPANY 332
Agency: Langeler Advertising Agency, Inc.
ROTO-FINISH COMPANY 314
Agency: The Jacqua Adv. Company

SARCO COMPANY, INC. 298
Agency: Rickard & Company
SCHAFFNER MANUFACTURING CO., INC. 300
Agency: Advance Advertising Company
E. E. SEELEY COMPANY, INC. 302
SELLERS ENGINEERING COMPANY 331
Agency: Simmonds & Simmonds, Inc.
SEL-REX PRECIOUS METALS 233
Agency: Bass & Company
SETHCO, INC. 298
Agency: Harry Hurat Advertising
THE SEYMOUR MANUFACTURING CO. 307
Agency: Claude Schaffner Adv. Agency
STEADFAST INDUSTRIES, INC. 220
Agency: Thomas & Brewer
FREDERIC B. STEVENS, INC. 258
Agency: Grant Advertising, Inc.
STORTS WELDING COMPANY, INC. 240
Agency: Harold S. Card
GEORGE A. STUTZ MANUFACTURING COMPANY 309
Agency: Sander Rodkin Advertising Agency, Ltd.
SULPHUR PRODUCTS COMPANY, INC. 294

TRAMER, GILBERT CO. 305
Agency: Claude Schaffner Advertising Agency
TRUE BRITE CHEMICAL PRODUCTS CO. 246

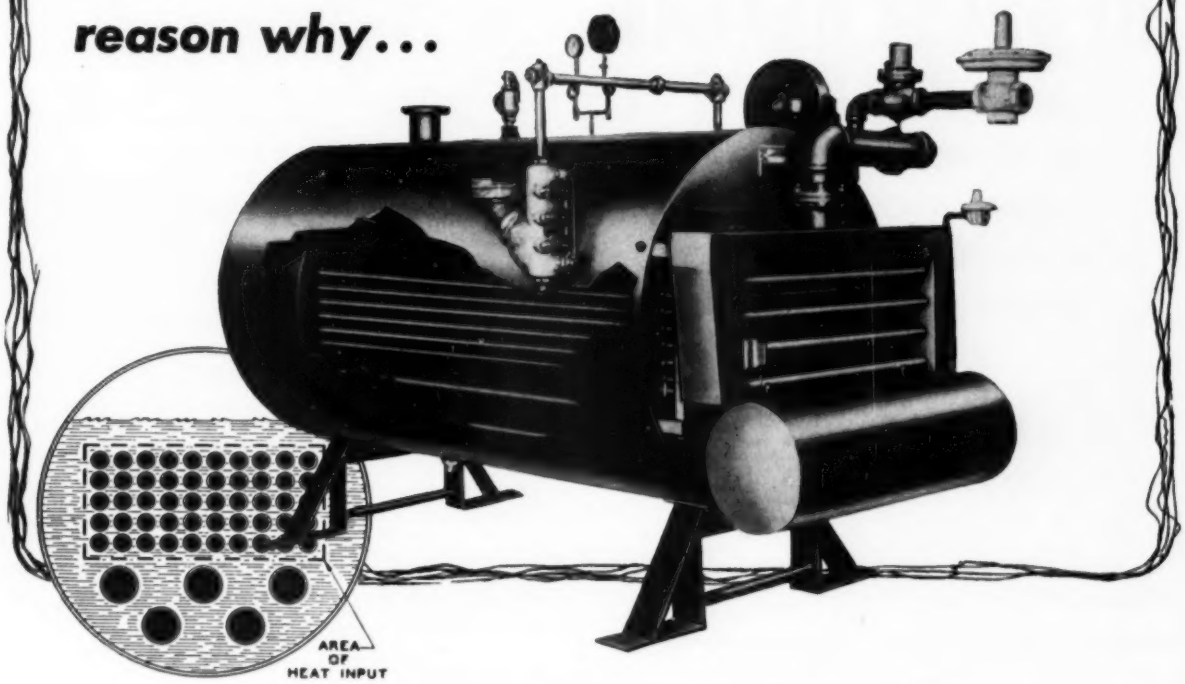
THE UDYLITE CORPORATION 287
Agency: Grant Advertising, Inc.
UNIT PROCESS ASSEMBLIES, INC. 332
Agency: State Advertising Service
UNITED CHROMIUM, INC. 289
Agency: Rickard and Company, Inc.
UNITED LABORATORIES CO. 292

THE VAN DORN IRON WORKS COMPANY 304
Agency: The Bayless-Kerr Company

WILLIAMSVILLE BUFF DIVISION, BULLARD CLARK CO. 288
Agency: Gordon Schonfarber & Assoc., Inc.
GEORGE WOODS CO. 296
Agency: M. A. Z. Associates
WORKLON, INCORPORATED 294
Agency: The Ettinger Company
WYANDOTTE CHEMICALS CORPORATION 286
Agency: Brooke, Smith French & Dorrance, Inc.

ZIALITE CORPORATION 300

There's a good reason why...



...IN SELLERS BOILERS "THE FIRE IS SPREAD OUT"

Remember how in hand firing a coal boiler, the old time fireman carefully spread his fire out — evenly distributed the fire over the grates? There was a good reason for it. He knew he'd get more steam per pound of coal — he knew "hot spots" in the fire bed could burn out grates, tubes and furnace plates.

There's the same good reason why in Sellers Gas Fired Boilers the heat input is evenly distributed over a wide area by means of numerous burners with individual firing tubes. "Spreading out the fire" puts every square foot of heating surface to work uniformly, prolongs life, improves internal circulation and increases operating efficiency.

SEND FOR BULLETIN 1206 PL-3

Your letterhead will bring you this tell-all, dollar-saving story on all 12 sizes!

Sellers ENGINEERING CO.

4876 N. CLARK STREET CHICAGO, ILL.

Immersion Steam Boilers

Blast Heaters

Immersion Tank Heaters

Combustion Units Industrial Gas Burners

Immersion Automatic Water Heaters

Vertical Steam Boilers

DON'T BE FOOLED BY FALSE CLAIMS

★

FINE BUFFING COMPOUNDS ARE A COMBINATION OF THE BEST OF MATERIALS AND YEARS OF MANUFACTURING EXPERIENCE.

★

ROBERTS ROUGE COMPANY

STRATFORD, CONN.

Originators of Micro-Lustre Finishers

Since 1881 A LONG TIME TO CONTINUE SUCCESSFULLY

USE READER SERVICE CARD; INDICATE A 393.

Future Meetings

AES Research Committee Meeting at the Lord Baltimore Hotel, Baltimore, Md., on Friday March 12, 1954 at 10:00 A.M.

Baltimore-Washington Branch, AES Annual Educational Session and Banquet on March 13, 1954 at the Lord Baltimore Hotel, Baltimore, Md.

Los Angeles Branch, AES. Annual Educational Session and Dinner-Dance at the Ambassador Hotel, March 20, 1954.

Cincinnati, Columbus, Indianapolis, Louisville Branches, AES sponsoring the 1st Annual Tri-State Regional Meeting, Saturday, April 3, 1954 at the Hotel Sheraton-Gibson, Cincinnati, Ohio.

Rockford Branch, AES. Annual Educational Session and Dinner-Dance at the Faust Hotel, April 3, 1954.

Milwaukee Branch, AES. Annual Educational Meeting and Banquet on Saturday, April 24, 1954 at the Schroeder Hotel.

THE FORCITE ANODE BASKET IS NO GAMBLE

The Forcite Anode Basket is designed to provide new convenience and economy to electroplating. It extends to all alkaline and acid plating baths (except chrome) the same convenience of anode maintenance which has become standard in cadmium plating using ball anodes. Constant anode area is easily checked by observation. *Exclusive* wedge contact provides positive current passage to each and every anode particle.

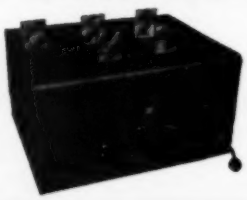
IT'S A NATURAL!

FORCITE CORPORATION
31450 Shake Blvd.
Chagrin Falls, Ohio

WRITE for details and name of nearest Forcite Distributor

USE READER SERVICE CARD; INDICATE A 394.

PERIODIC-REVERSE UNITS



Of the Finest Quality for

PLATING

In the Modern Way

Write for Information

UNIT PROCESS ASSEMBLIES, Inc.
75 East 4th St. New York 3, N. Y.

USE READER SERVICE CARD; INDICATE A 395.

CHEMSTEEL CONSTRUCTION COMPANY, INC.
301 Chemsteel Building, Walnut Street, Pittsburgh 22, Pa.

(No "tie-in" with any manufacturer)
Send data on your Design, Engineering, Material, Construction and Maintenance Facilities for
ACID-ALKALI-PROOF CONSTRUCTION
backed by experience serving major steel, chemical, textile and food industries in erection of
PICKLING, PROCESSING & STORAGE TANKS & FLOORING

NAME .....
COMPANY .....
ADDRESS .....
CITY ..... ZONE ..... STATE .....

TEAR OUT AND MAIL

USE READER SERVICE CARD; INDICATE A 396.

for CLEANING DIECASTINGS use...

DIECLENE ES
FOR ZINC BASE DIECASTINGS

New, Highly inhibited, electrolic reverse current cleaner for zinc base diecastings that will not discolor or tarnish highly buffed castings even under prolonged electrolysis. Eliminates blistering and peeling. Aids in producing bright, lustrous, stain free plating.

METEX 191
SOAK CLEANER FOR ZINC BASE DIECASTINGS

New, Economical, fast acting, alkaline soak cleaner which is highly inhibited for removing heavy impacted buffing compounds. Does the job of emulsion cleaners without the danger of solvent carryover. No fire hazard.

METEX A SPECIAL

New — entirely different spray washing machine cleaner. By incorporating non-foaming characteristics along with new dispersants, we produce soak tank cleaning results in a spray washer.

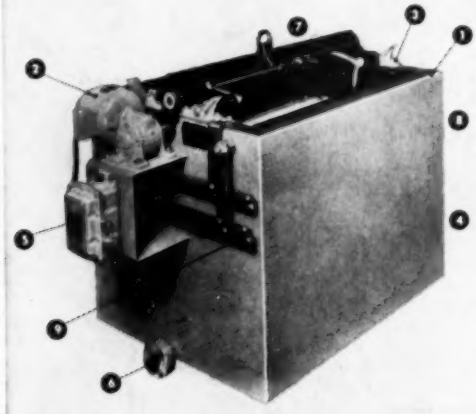
Write or call today and we will have a trained Metal Finishing Engineer call to tell you about these new diecast cleaning compounds which eliminate all fire hazard solvents.

MAC DERMID
★ *Incorporated* ★
WATERBURY 20, CONNECTICUT

FOR 32 YEARS ORIGINATORS FOR THE METAL FINISHING INDUSTRY

NOW... this improved
H-VW-M Mercil-Type Plating Tank with Submerged Cylinder

plates faster
reduces maintenance cost
permits larger loads

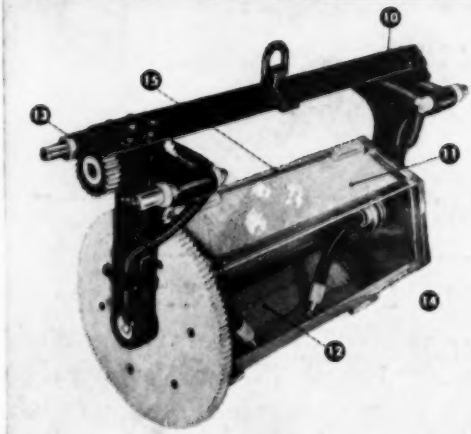


by combining *all* these features for better barrel plating:

1. **TURNED-IN FLANGES**—save space, provide enclosure for hanging heating and cooling coils.
2. **RELOCATED, MORE COMPACT MOTOR DRIVE**—drive shaft *now* above solution level, preventing leakage through shaft openings in tank walls.
3. **REDESIGNED SADDLES**—make barrel positioning far easier.
4. **NO OVERFLOW TROUGH**—not essential with this improved design, saves space inside tank.
5. **PUSH-BUTTON TYPE MOTOR STARTER**
6. **BOTTOM DRAIN**
7. **COIL RISERS**—extending over top of tank.
8. **ANODE RODS**—2 for each cylinder on both single and multiple units.
9. **BUS BARS**—positive and negative on *each* end of tank for equal current distribution.

These *improved* tanks are constructed of ¼" double-welded steel plate in 2 sizes, 14" x 30" I. D. (224 gal.) and 14" x 36" I. D. (252 gal.). For acid solutions, tanks are lined with ⅛" vulcanized rubber or plasticized PVC. For cyanide solutions, rough-wire glass is used in back of anodes. Finish is rust-resistant grey enamel with black trim.

TOGETHER, *They Form the Ideal Combination for Better Barrel Plating!*



10. **IMPROVED HANGER ASSEMBLY**—now made of rigid angle-iron, improved to insure proper barrel alignment.
11. **ONE-PIECE PANELS**—Plexiglas: ½" thick, no ribs. Melamine: ¼" thick, ribbed.
12. **CONVEX TUMBLING SURFACES (Plexiglas only)**—for added strength, easier tumbling action.
13. **MELAMINE BUSHINGS**—for insulating bronze hanger pins.
14. **EASY LOADING & UNLOADING**—cover with handle in panel area is easily reached at all times.
15. **SECURE BONDING**—all molded parts firmly bonded with cement and monel screws.

These *improved* cylinders are available in either Plexiglas, for temp. to 180°F., or Melamine, for temp. of 200-210°F. (Melamine has excellent resistance to abrasion). Hexagonal in shape, with 1" thick heads and special convex (Plexiglas only) one-piece panels, they are designed for greatly reduced maintenance cost and engineered for use *completely submerged* . . . with outstanding results: more consistent plating, 20% higher load capacities, 25% faster plating. And, in zinc baths, total submersion minimizes chance of spark igniting gas above bath.

For complete information on improved H-VW-M Mercil-Type Tanks and Cylinders ask for Bulletin PB 109.

PARTNERSHIP

Your H-VW-M combination—of the most modern testing and development laboratory—of over 80 years experience in every phase of plating and polishing—of a complete equipment, process and supply line for every need.

HANSON-VAN WINKLE-MUNNING CO., MATAWAN, N. J.
PLANTS AT: MATAWAN, N. J. • ANDERSON, INDIANA
SALES OFFICES: ANDERSON • BALTIMORE • BOSTON CHICAGO • CLEVELAND • DAYTON • DETROIT • GRAND RAPIDS • LOS ANGELES • LOUISVILLE • MATAWAN MILWAUKEE • NEW YORK • PHILADELPHIA • PITTSBURGH ROCHESTER • SPRINGFIELD (MASS.) • STRATFORD (CONN.) UTICA • WALLINGFORD (CONN.)

H-VW-M

INDUSTRY'S WORKSHOP FOR THE FINEST IN PLATING AND POLISHING PROCESSES • EQUIPMENT • SUPPLIES

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 398.